

## ARCHIVES OF OTOTOLOGY.

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THE OTOPHONE, ITS HISTORY, WITH A DESCRIPTION OF ITS VARIOUS FORMS, ITS USE BY THE DEAF, ITS VALUE AS AN AID TO RESTORATION OF HEARING, AND IN THE INSTRUCTION AND DEVELOPMENT OF HEARING AND ARTICULATION IN THE DEAF-DUMB.

By J. A. MALONEY, WASHINGTON, D. C.

SOME years since, while experimenting in the field of acoustics, the thought occurred to me that a new field might be opened for relieving the deaf by constructing the agent of relief to meet the requirements of defective audition in each case as nearly as possible. To that end, after study of the anatomy and physiology of the ear, together with such light as the limited literature upon "Physiological Acoustics" afforded, I commenced my labors in "Aural Mechanics," with a mode of procedure as follows:

1st. To develop instruments as far as I could to meet the various phases of defective audition;

2d. To construct the instruments to give satisfactory results without entering the auditory canal;

3d. To use artificial drums or membranes to guard against impact of air upon the *membrana tympani*, and prevent reverberation or disagreeable resonance so common in all the old forms of instruments.

I decided that a scientific instrument should possess these three essential qualities: It should be large enough to be of practical value; it should augment sounds; but with such augmentation the timbre or quality of sound should be preserved.

The augmentation and clearness must be to the extent

that the person will hear every word spoken, instead of a word here and there, as heretofore, which involves a severe mental strain to construct the incomplete sentence.

We are all aware that the *membrana tympani*, unlike other stretched membranes, responds to all vibratory motions within a certain limit, whether they are in the form of noise or of composite tones, transmitting, through the intermediate agencies of the middle and inner ear, to the nerve of hearing auditory sensations. Could a stretched membrane be arranged that closely imitated in function the one given to man?

After experimenting twelve months I adopted the form of membrane which is here presented. See figs. 1 and 2. The reasons for its adoption came about in this way: In the early stage of my experiments I invariably found a lack of clearness of tone, until one day the thought occurred to me that I could secure uniformity of tension by clamping the membrane between two rings. When this was done I found it a great improvement over all other methods, and consequently adopted it after thorough tests. Even after obtaining good results I could not but feel that there must be some other result produced by the rings than that of maintaining a uniform tension of the membrane. I found that while the membrane was upon the stretcher-frame, with the rings glued upon each side of it, like any other membrane, it would be thrown into sympathetic vibrations by tones corresponding to its fundamental; *but that when cut from the frame*, and dependent for its tension upon the two rings alone, it did not exhibit excessive sympathetic vibrations of its own fundamental, but was very sensitive to composite tone vibrations. Now it has been thought that the last-named feature exhibited by the *membrana tympani* was produced by its union with the auditory ossicles. But may it not be due to two facts? 1st. That the margin is thickened; 2d. That the middle layer, or *substantia propria*, is fixed to a ring of bone.

The instruments are known as Nos. 1, 2, 3, No 1 being used simply to render clear and distinct all sounds to those partially deaf. No 2 is a small instrument, and is fastened

to the auricle by a locking device, kept in place by the *tragus*, *antitragus*, and *concha*.

No. 3 is used by those extremely hard of hearing, and also as a restorative agent by means of exercise through the natural means, *i. e.*, the voice, which at the same time (by reason of clearness of tone) overcomes the sluggishness or dulness of the "percipient tract." This form is intended for use in the education of the deaf-dumb.

The following cases will give results from use of instruments:

Mr. C., aged sixty-five, while in Washington called upon me and said he had always had difficulty in hearing, but more so of late years. Upon examination I found malformation of auricle, the space between *helix* and *tragus* being very narrow and the *concha* very shallow. The person could hear an ordinary tone

Fig. 1.



Fig. 2.



about four feet away. Upon placing one of No. 2 in each ear (being made to suit the shape of each ear), he was able to hear the same tone at a distance of twenty-five feet.

Mr. M., aged forty-seven, could not hear at a distance of three feet ordinary conversational tones. I found malformation of auricle. Upon making and fitting a pair of No. 2 arranged to suit his tone defect, he could hear distinctly a conversational tone a distance of thirty feet.

Mr. H. H. F., of Philadelphia, aged fifty (sent by Dr. S. Weir Mitchell), I met at the office Dr. Chas. H. Burnett in Philadelphia. He was very despondent, and I found that an ordinary tone spoken at the meatus by Dr. Burnett could not be heard. Upon applying a No. 3 otophone he heard every thing said in a very low voice, and without any difficulty could distinguish between B, P, and T, much to the surprise and joy of the person, who exclaimed: "Why, with this, every sound comes to me clearly and naturally! Heretofore I have had to go to the words without much success."

Mrs. G. P., aged sixty-five, could hear loud tone close to meatus. With instrument could hear conversational tones clearly and with relief to members of her family, who had difficulty in making themselves heard with old forms of instruments.

Mr. M., eighty-five years of age. The following is from the physician who ordered an instrument: "His eighty-five years sit more lightly upon his aged body. In fact it has opened up a new world to him."

Mrs. McC., aged fifty, had used all kinds of instruments prior to use of No. 3. Her physician reports it a comfort to her family and improvement to patient by its use.

Mr. G. W., aged fifty-five, extremely hard of hearing for twenty years, could hear a loud tone when spoken close to meatus. Finds the instrument a great assistance, and in thirty days could hear a low tone eighteen inches from meatus without instrument.

Dr. J. H. B., aged thirty-two, presented himself for test at the meeting of the Medical Society of the District of Columbia, May 4, 1887. Could not hear a loud tone close to meatus on right side. With instrument could hear every word spoken in a low tone. Commenced to exercise that side. He is now able to hear a conversational tone at a distance of fifteen feet without instrument.

C. H. M., aged forty-five. An engineer retired from U. S. Navy by reason of deafness. Had been using No. 3 Otophone four weeks when he wrote: "It is helping me."

The following will show results upon the deaf-dumb, produced at the Pennsylvania Institution for the Deaf and Dumb (Philadelphia) at the suggestion and under the supervision of Dr. C. H. Burnett.

*a.—Congenital Deafness.*

(1.) Ida B., aged twenty-one years. Has a deaf brother. She cannot read the lips. Has been eight years in the institution. The vowels were repeated to her three times in succession through the otophone, first at the right ear. She noticed a difference in the sounds, but could not indicate which vowels were being repeated to her. The left ear was then tested, and she indicated O twice, correctly, and noticed when the ear-piece slipped below the meatus, and so informed us. With this case test-words were



also employed, these being Philadelphia, Mississippi, Burlington, written and then pointed out to the pupil during their repetition. She indicated Mississippi and Philadelphia, and then Mississippi, again and again, when it recurred in the testing, but failed to get "Burlington."

(2.) Emma R. K., fifteen years old ; has deaf parents and a deaf maternal uncle ; also a brother a deaf-mute in the Institution. She has been four years in the school. She perceived sound by the otophone, and said, after the vowels were repeated to her three times, that A and U are different. She indicated correctly A, O, and U, missing, of course, a number between the successful replies.

(3.) John K. (brother of the previous case), sixteen years old ; heard sound in right ear through the tube, but failed to indicate correctly, after the testing by five vowels. Three vowels were then tried, viz., A, E, and O. He said they all sounded alike excepting E, but he indicated correctly O. No results in testing left ear. The word-tests were then employed, as in the previous case. Successfully indicated "Mississippi" and "Burlington." "Missouri" was now added to the word-tests, and "Missouri" was successfully indicated three times in succession. Of course there were numerous misses, but the successful indications were manifestly not guesses.

(4.) James P., seventeen years old ; *parents both mutes, father a congenital mute, the mother such by acquisition. He has also two congenital mute sisters, a deaf uncle, and a deaf aunt.* He perceives the sound of the word, Halloa ! through the otophone, and says it is disagreeable, but does not hurt. The five vowels were first tried in this case, with the left ear. A and O successfully indicated, E mistaken for U and I. The right ear was then tried, and A, I, O, and U were indicated. The word-tests, the four words already employed, were then repeated to him three times, and they were all correctly indicated. So striking was this result that Mr. Crouter, the Superintendent, felt that in one who was supposed never to have heard, it must be successful guessing.

(5.) May S., fifteen years old, sister of case 1. Has been in the Institution four years. Tried three vowels, A, E, and O, three times repeated in the right ear, and pointed out to her at the same time. She pointed out successfully, when repeated, O several times, and A and I mistaken for E. Left ear, A and O a number of times successfully indicated. The word-tests were then employed in the right ear, the four already named being repeated

three times in succession. Then when the pupil was requested to indicate what was repeated, she succeeded in indicating Philadelphia, Mississippi, Burlington, and Missouri, a number of times correctly.

The vowel O, was once understood by her as *boy*. *Boy* was then written and repeated to her, being at the same time pointed out to her, and when given among other test words, it was correctly pointed out by her each time.

*b.—Acquired Deafness.*

(6.) Mary J. McD., nineteen years old, no deafness in her family. She became deaf at four years of age, after she had learned to talk; but has since lost the ability to talk. With the right ear does not distinguish the vowels. In the left ear she says they "sound loud." The vowels were then repeated and pointed out to her three times, as already described. She got O, several times, then A, I, O. Word-tests, *papa, mama, baby, boy*, were then employed, and she successfully indicated *mama, baby, and papa*.

(7.) Annie S., seventeen years old, became deaf at four years of age. No deafness in her family. She once spoke German, her mother-tongue. O was perceived correctly by the left ear; she "feels it a little in the right ear."

(8.) Sarah E., nineteen years old, became deaf at three years of age. Has no deaf relations. The vowels A, I, and O, were first used as tests. She indicated successfully, O, A, and I, repeatedly by the left ear. In the right ear, I and O were said to sound alike—O was heard best, I next, and A, third.

(9.) Geo. L. H., aged seventeen years, became deaf at the age of three and a half years, after he had learned to talk, but since has lost the ability. Has no deaf relations. He says he feels the sound in his left ear. First tested with an A, I, and O; all successfully indicated. Then tested by means of A, B, and O. He successfully indicated B, A several times.

(10.) George G., eighteen years old, became deaf from measles at four years of age, after he had learned to talk. Perceives sound "just a little" through the instrument.

(11.) Harvey De L., nineteen years old, became deaf at the age of five years, from spotted fever. He perceives a little through the right ear.

(12.) Oliver E., eighteen years old, became deaf from a catarrh at six years of age. Can speak. In the right ear "feels"

the vowels a little. Indicated correctly three times A and I. No word-tests, like those previously used, were employed, as the results with the vowels, in the cases of acquired deafness, were not as good as in the so-called congenital cases.

*c.—Semi-mutes.*

Tests were made in the cases of two boys with acquired deafness and instructed like mutes ; but still able to talk, and to hear some.

(13.) Benj. G., seventeen years old, became very deaf at nine years of age, probably from a purulent process, as indicated by the membrana tympani. This boy heard every thing said to him through the otophone, and returned intelligent articulate answers to all the questions.

(14.) Thos. O'B., aged eighteen years ; became deaf at the age of four years, from spotted fever. He hears very well by means of the otophone.

The articulation in such cases could, without doubt, be greatly improved by the use of such an instrument, if its employment as a means of instruction could be begun early in life. Also the function of hearing could be better retained and perhaps improved by the normal exercise it would obtain by hearing through the otophone.

The following tests were made at the National Deaf-Mute College, Washington, D. C., under supervision of Dr. F. B. Loring, and in the presence of Dr. Gallaudet and Profs. Gordon, Denison, and Ballard. The tests were made with an otophone No. 3. The following is from the report of Dr. Loring :

The method used was to write five vowels on a piece of paper which was placed in the hands of the person being examined ; then the particular vowel spoken through the otophone by Mr. Maloney, was pointed out by Mr. Wight. This was repeated three times in order to impress the different sounds of the letters upon the ear. The pupil being then required to point to the vowel given—two consecutive ones at no time being used. Words were also written in the same way, viz., " Mississippi," " Baltimore," and " New

York." The number of vowels in some cases was, however, reduced to three, as five were found to be too many to be carried in the memory of the deaf and dumb, as it must be borne in mind that names and letters convey no impression to the deaf-mute, and that he is not by any means on the same footing as a "hearing person" (as they themselves express it) who has lost hearing late in life. In other words his ear may recognize distinctly the different sounds as given through the otophone, while his memory entirely unpractised as regards sound may not be able to refer it correctly to the vowel indicated.

The tabulated result of the thirteen cases was as follows:

CLASS I.—*Congenital.*

W. A., age seventeen; distinguishes five vowels correctly after they have been repeated four times.

Mr. S., age twenty-three; distinguishes all vowels.

Mr. O., age sixteen; repeats three vowels; cannot carry five; also distinguishes between "Mississippi" and "Baltimore."

L. S., ten years; no improvement, and complains of pain.

Mr. T., age twenty-four; can recognize three vowels.

CLASS II.—*Hearing lost between ages of one and five years.*

Mr. H., twenty-one years; lost hearing from scarlet-fever at five years; hears all vowels.

Mr. H., nineteen years; lost hearing at eleven months; hears and repeats all vowels, also three words.

Miss A. W., fourteen years; lost hearing from scarlet-fever at three months; gets A, O, and I.

N. L., aged twenty-three; lost from brain-fever at two years; no improvement; no conduction, either aërial or osseous.

Mr. R., age nineteen; spinal meningitis at five years; hears and repeats four vowels out of five, also "Boston" and "Mississippi"; cannot distinguish between "Baltimore" and "Boston."

CLASS III.—*Semi-mutes.*

Mr. D., forty years; deaf on one side to such an extent that no sound could be distinguished on the other; could converse with trumpet; this condition had existed for over thirty-five years.

With otophone hears conversation easily with worse ear, and with the better one the instrument can be removed for at least four inches from contact with concha.

Case number two in this class is a curious one; he has been educated as a deaf-mute and uses the sign language entirely, making his replies verbally, speaks naturally, and is an expert lip reader. With the otophone, however, he understands conversation perfectly with either ear.

Mr. H. has a natural voice; lost his hearing from scarlet-fever at five years; is now twenty-nine; hears all the vowels and is doubtless capable of much improvement.

In view of the results obtained (as shown by the foregoing cases) in the appeal to sight, hearing, and memory, I shall conclude by calling attention to the following from a pamphlet by Samuel Sexton, M.D., New York, 1884, "On the Necessity of Providing for the Better Education of Children with Defective Hearing in the Public Schools," pp. 14, 15:

*"The importance of early training for deaf children.*—Too much stress can scarcely be laid on the value of results obtainable in this way if early made, since the perceptive power may be much quickened by training in many instances, even where the middle-ear apparatus is defective. It would appear to be on the development of the perceptive tract, rather than on any change in the transmitting mechanism, that mental improvement depends in the very deaf who are taught aurally. The expert himself finds it no easy task to get at the facts in certain cases, especially in young children who have already been instructed as totally deaf, since they soon come to disregard the hearing sense entirely, and it remains to be determined in such cases how much the auditory nerve has deteriorated from disuse. The professed indifference to hearing should never prevent some attempts being made at instruction through the hearing organs, since a surprising amount of hearing may thus be found to exist. How many children one meets with who are backward in learning to talk, but finally, on getting to be three or four years old, gain their speech! Such chil-

dren would get on much faster in many instances, it is believed, if regarded as partially deaf. While treating such children professionally I have seen beneficial results from the use of conversation-tubes, or the employment of voice at close range. This practice cannot be too early commenced. I have observed good results in children as young as eighteen months. In observing these cases one cannot but be impressed with the importance of normal hearing in the ready acquirement of speech, and that however imperfect the hearing may be, it has its uses in acquiring languages."

This is a very clear presentation by Dr. Sexton of the needs of the deaf and deaf-dumb, in whose behalf he has spent so much time and thought.

Also the following from Dr. C. H. Burnett before the Philadelphia County Medical Society April 27, 1887. (See *Medical News*, May 7th.)

#### EAR-TRUMPETS.

"There are three reasons, he said, why the deaf should use ear-trumpets :

"1. In order to aid the hearing. 2. To improve the hearing. 3. For the convenience and comfort of those conversing with the very deaf.

"1. The cause of ordinary deafness is, in most cases, a catarrhal thickening of the mucous membrane over the ossicles and the inner surface of the membrana tympani, leading to more or less ankylosis in these parts. Passive motion overcomes in them, to a greater or less extent, the immobility induced by this sclerotic process, as it does elsewhere in the osseous and muscular system. The form of passive motion which acts most naturally on the ossicula auditus and their joints, is sound. If, therefore, sound-waves are concentrated in more than usual quantity or vigor upon the stiffened membrana and the ossicles, as by means of an ear-trumpet, hearing is induced, if the auditory nerve is unimpaired. If the latter is impaired, no form of ear-trumpet will be of use.

"2. Not only does such a form of passive motion give immediate relief to the deafness in most cases, but such a



form of passive motion, acting frequently and systematically upon the ear, prevents further ankylosis in the conductors, and fatty degeneration of the auditory nerve from desuetude. This, of course, tends to a permanent improvement of the hearing, and, in some instances, patients come to hear at last without a trumpet. If such a force were brought to bear early in cases of deafness from ankylosis in the ossicula, the defects in hearing could, in most cases, be arrested, and, to some extent, removed. This form of aid to hearing has its happiest results in very deaf children, in whom the loss of hearing often entails loss of speech, if they have already learned it. If they have not learned to talk, and their deafness depends on catarrhal disease in the middle ear, and not on a lesion of the acoustic nerve, the use of a good ear-trumpet will rescue them from entire deaf-dumbness.

"3. The most useful ear-trumpets yet presented to his notice are those of Mr. Maloney, who exhibits them here to-night. They are not only useful as conductors of sound, succeeding where other forms fail, but they do not fit into the meatus. They are held to the ear, the aural end of the instrument being supplied with a disc, and not a tip for the meatus. This does away with bruising the canal, or exciting furuncles in it, so common in the employment of the forms heretofore in use. They have been devised in a scientific manner, and introduced to the profession on their own merit. The best results, or the most signal ones, have been obtained by the so-called silent instrument. This is simply because it is the most powerful, and hence renders most aid to the very deaf, the only people who are really willing to use any instrument. The smaller instruments are just as good for those not very deaf, and, if used by such patients, would aid in the retention of hearing, and tend to cure their hardness of hearing, as he has shown. But the less-afflicted class seem unwilling to use any form of ear-trumpet. All ear-trumpets of any value must possess some size in order to contain a column of air sufficient to impress the drum. They must be larger than the auricle with which the patient is already supplied. Hence, all invisible appliances, so-called, are self-evidently good for nothing."

ON THE DIAGNOSTIC VALUE OF RINNE'S EXPERIMENT, WITH REMARKS ON THE PHYSIOLOGICAL FUNCTION OF THE SOUND-CONDUCTING APPARATUS.

By F. BEZOLD, of MUNICH.

Translated by J. A. SPALDING, Portland, Maine.

THERE is one peculiarity about the examination of the functions of the ear, and that despite the undeniable inefficiency of our present audiometers, in which we have an advantage over the other organs of special sense, and this is that we can produce the same irritation in two different ways, by aërial and by bone-conduction.<sup>1</sup> And further the patient can assist us by comparing directly with one another and measuring the variation in intensity of any given tones of the same force acting successively upon the ear by A. C. and B. C.

Ever since E. H. Weber discovered that a T. F. placed upon the vertex of the skull could be heard better in the obturated ear, innumerable aurists have endeavored to draw diagnostic conclusions from this observation which was soon discovered to be invariably present in cases of simple stoppage of the meatus, as well as in the greatest variety of disturbances in the sound-conducting apparatus.<sup>2</sup>

Weber's experiment is of no assistance in comparing B.

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<sup>1</sup> For the sake of abbreviation, the initials A. C. and B. C. will be largely employed throughout this translation for aërial, or bone-conduction, and further, T. F. shall signify tuning-fork, whilst when the plural of that compound word is intended, T. FS. will be employed.

<sup>2</sup> Schwartz's text-book, vol. i., p. 54, contains historical references (extending back to the year 1509), on the use of bone-conduction for diagnostic purposes.

C. with A. C., it simply shows the difference between the B. C. of the more affected ear and that of the less affected or healthy ear.

There are three methods of comparing the aërial and bone-conduction in any individual.

1. The simplest method of comparing the aërial or as we may call it the aëro-tympanal conduction, with the osteo-, or really cranio-tympanal conduction as Hensen styles it owing to the path which it follows, is to take a T. F. as free as possible from over-tones, to strike it against some hard substance, and then hold it in front of the ear till it ceases to sound, and then after striking it again, to let it cease to sound on any spot upon the skull. This method presupposes that the same part of the T. F. is struck twice in succession with the same force, a thing that can apparently be accomplished by means of an apparatus attached to the fork as described by Eitelberg.<sup>1</sup> But in this method there is great opportunity for errors in bone-conduction, owing to the fact that we cannot accurately measure the precise pressure with which the T. F. is held against the skull.

2. This error can be partially avoided by supplementing the A. C. and B. C. of the diseased ear with those of the normal, *e. g.*, our own ear, in that we measure how much longer the T. F. is heard by our ear, or shorter by the diseased ear, and then compare the results.

3. Rinne's experiment depends exclusively upon the amount of time by which the T. F. is heard longer by the tested ear by A. C., or under pathological conditions longer by B. C. than by the opposite form of conduction.

Although Rinne placed this experiment at the head of his papers on the physiology of the human ear, as far back as 1855, emphasized its constant occurrence in the healthy ear, and also correctly recognized its importance for our differential diagnosis, it nevertheless remained practically unutilized until in the last decade Lucae consistently employed this method of investigation in the chronic forms of deafness, noticed its occasional negative condition, and thus

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<sup>1</sup> These ARCHIVES, vol. xv., 299.

drew toward it once more the universal attention of aural surgeons.

The diagnostic value of these three methods has since been investigated by innumerable otologists with the assistance of other tests and experiments, and now one, and now the other has been pushed into the foreground as by far the most useful of them all, but we are still far from uniting upon one which shall best answer our theoretical demands and practical needs.

I have in the last six years, but without neglecting other methods, relied entirely upon Rinne's experiment as the crucial test in every case in which slightly pronounced alterations or none at all existed in the M. T., or whenever auscultation failed to solve the question of a diagnosis between an affection of the sound-conducting and sound-perceiving apparatus, and in the last three years I have noted its duration in seconds.

In a paper, "On the explanation of the relation between ærial and bone-conduction in Rinne's experiment,"<sup>1</sup> which I read before the Otological Society of Munich in 1885, I attempted to explain theoretically why B. C. so often exceeds A. C. in affections of the sound-conducting apparatus. The chief reason for that lay, in my opinion, in an increased tension of the sound-conducting apparatus, such as we have a right to assume in a great majority of diseases of the middle ear.

It seems to me a much more difficult task to demonstrate from a large mass of material the *statistical* value of the significance and practical applicability of Rinne's experiment, and all the more so, since long series of the same nature have lately been published, a large majority of which corresponded but slightly to our suppositions, whilst many were doubtful, and some entirely negative.

If we theoretically consider the relative reliability of the three methods just described, we shall see that Weber's experiment demands that the patient shall simultaneously direct his attention to impressions of hearing on *both* sides,

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<sup>1</sup> Published at Finsterlin's in Munich in 1885.

and then decide which of the two preponderates, or if the difference between the impressions is more pronounced, he has to decide in which ear the tone exclusively resonates. V. Troeltsch, in his work on the ear, long since emphasized the difficulty of this experiment even in the case of intelligent patients. This is especially true in the chronic cases in which bone-conduction is nearly all that we have to rely upon for our diagnostic purposes, whilst in the acute and sub-acute catarrhal diseases of the middle ear, and in suppurative cases, as well as in those processes chiefly confined to the Eustachian tube, the patients' answers upon this point are more precise. How often, too, the chronic affections are nearly *evenly* divided on the two sides, is seen in the following tables. In cases of the latter sort, therefore, it is plain, from the start, that we cannot safely rely upon Weber's experiment for any decisive diagnosis.

The patient is not required in the other methods to differentiate between the relative strength of simultaneous impressions of sound in both ears, but to determine one after another the audible limits of B. C. and A. C., or in other words he has simply twice to determine the "*threshold irritation*," *i. e.*, the minimum intensity which, in any given case, produces a perception. Inasmuch, therefore, as the threshold irritation is relied upon as a suitable and trustworthy aid in long series of psycho-physical and physiological investigations, and particularly so in the case of the organ of hearing in its normal state, we are justified in employing the same means in our diagnostic tests in the diseased ear. According to Vierordt,<sup>1</sup> "of course the perceptive force of any two persons cannot be precisely compared, but we can compare their threshold sensations, in regard to which we have the undeniable right to assume that they are substantially alike"—for which reason, "these measurements are free from any thing subjective."

Hessler has shown, by a long series of tuning-fork investigations upon his own person,<sup>2</sup> that there are but relatively few errors in determining the threshold value of the ear.

<sup>1</sup> *Die Schall und Tonstaerke*, Tübingen, 1885.

<sup>2</sup> *Arch. f. Ohrenheilkunde*, xviii., p. 227.

Despite the fact that his T. FS. were strong in tone, and slow in ceasing to sound, the variations in value so obtained were so slight as to be of no account at all in comparison with the audible duration of vibration of the forks as a whole, at least so far as all practical measurements were concerned.

Practical considerations alone ought to determine which of the three methods we are to prefer and to call the regular one in every case in which we test the relation between B. C. and A. C.

In the first method we have to determine, by a long series of normal ears, the precise length of time during which the T. F. employed can be heard, both by A. C. and B. C., since we do not yet possess any normal standard tuning-fork. In the second and third methods, however, there is no necessity for this preliminary determination of the normal audibility of the T. F. And we are entirely independent of the force with which the fork is struck. If, by the second method, we only measure the time which intervenes between threshold perception of the diseased ear and of our own healthy ear for A. C. and B. C.; and in the third, Rinne's experiment, measure exclusively on the diseased ear the time which lies between the threshold perception of sound when heard by B. C., and the same perception by A. C., or inversely, it is a matter of indifference how forcibly the T. F. is originally sounded, and the values in seconds as discovered and tabulated in a large number of patients are easy to compare with one another, if they have only been taken with one and the same T. F. In order to avoid all weariness of the ear, we should invariably begin with the weakest possible tone.

Since the great number of persons whom it is essential for us to examine by these methods for the sake of obtaining accuracy of diagnosis, demands an inordinate degree of attention, and largely infringes upon our practice, we must take into consideration the length of time which is needed for the different methods, and give the preference to that which gives the most useful results in the quickest possible time. And further still, in order to economize our



time in each experiment, we must remember that a large number of investigators are now agreed that it is well in every case to go through with these tests with at least two T. FS. that vary extensively in pitch.

Rinne's experiment is quickest to perform, and the least wearisome. It does not tell us directly how much the hearing by A. C. or B. C. is diminished in comparison with the healthy ear, but it gives us instead that proportion which, as experience teaches us, is subject to the greatest variations in the disease with which we are here concerned, and therefore offers the most striking figures, whilst Rinne's assertion that the experiment always results positively in the healthy ear, has been unanimously confirmed by all authors.

Rinne's experiment should always be amplified by testing the B. C. by the second method. Emerson<sup>1</sup> showed how often the B. C. of a diseased ear surpasses that of a normal ear, and Schwabach, in his extensive statistical paper<sup>2</sup> on the value of Rinne's experiment, directed particular attention to the period of time for which a T. F. placed upon the vertex of a deaf person is heard longer or shorter than by a person whose hearing is normal, and has discovered from the positive or negative result of this experiment an important and further support for differential diagnosis between diseases of the middle and inner ear.

It would also be desirable to know how much the duration of A. C. is reduced in comparison with that of the healthy ear (measured according to the second method) in each individual case and for forks of varying pitch. This measurement, however, especially for a T. F. with a deep tone and one that slowly ceases to sound, is subject to the most extraordinary variations when repeated in the same persons, as some time since discovered by Schwabach, who also noticed at the same time that the duration of the perception by B. C. was much more constant. On the contrary the A. C. for *high* tones can be more advantageously studied with Lucae's *c*<sup>iv</sup> and *f* sharp<sup>iv</sup> forks in the method sug-

<sup>1</sup> These ARCHIVES, vol. xii., p. 63.

<sup>2</sup> These ARCHIVES, vol. xv., p. 195.

gested by that author. Besides all this it is my opinion that we cannot dispense with the additional use of Galton's whistle, as suggested by Burckhardt-Merian, particularly in testing the highest tones of the scale, for in comparison with the tuning staff, it has the great advantage of containing, in immediate sequence, the three upper octaves of our perception of sound. It would be desirable, from a theoretical point of view, to test for A. C. and B. C. the entire scale, or at least a long series of tones evenly distributed over the entire scale, perhaps the entire octaves, as Hartmann has done in an extensive series of cases for the middle portion of the scale, which is after all the one with which human hearing is chiefly concerned. The complete gratification of this postulate is, however, impossible, as is also the construction of an audiometer corresponding to these ideal demands, and for the reasons that on the one hand we cannot find very deep T. F. S. that are free from over-tones, and on the other, that when the T. F. is higher than  $a''$ , B. C. can no longer be carefully tested by itself, because the loud forks absolutely needed for perception in these cases, are audible to so great a distance that A. C. cannot be scientifically excluded from the investigation.

We are therefore obliged, especially for a regular examination that can be employed in every case, to content ourselves with testing a limited series of tones, and must give those the preference whose perception, as experience teaches us, most frequently suffers alteration—that is to say, the high and low tones.

Our chief aim ought, however, to be, so far as practical needs of hearing are concerned, to test invariably the most important *middle* portion of the scale.

I have for years for this purpose resorted to the common tuning-fork  $a^1$ , so generally found in the hands of musicians, and of which I own one that, if not struck too hard, is entirely free from over-tones. Its limbs are 8.2 cm long, 9.2 mm wide, and slightly more than 3 mm thick. The thin handle terminates in a round button. If permitted to vibrate freely in the air, it can be heard for 80 seconds by a person of normal hearing, 11 seconds if placed upon the

vertex, and then 30 seconds more by aerial conduction if held in front of the meatus.

Although its tone lies somewhat higher in the scale than the *a* and *a'* forks generally used by the observers of Rinne's experiment, the tables appended show that with this middle tone of the musical scale such remarkable variations are obtainable by Rinne's experiment, that this T. F. alone is capable of giving us entirely satisfactory diagnostic results.

I have of late found that I could not dispense with a second and deep T. F. for controlling and amplifying the results obtained by the *a'* fork. But the over-tones are too disturbing in a large contra A fork with arms 35 *cm* long, and a tone in the third octave below, whilst its size renders it somewhat unmanageable. In its place, therefore, I have lately employed an almost equally large fork, A (two octaves below *a'*), which, as the tables show, is of so great service in testing B. C., to say nothing of its value in Rinne's experiment, that I earnestly recommend its use in the same form in which I have employed it. Its arms are 25 *cm* long, 19 *mm* wide, and  $7\frac{1}{2}$  *mm* thick. The over-tones of this fork, also, were originally very disturbing, but by means of a very simple contrivance I have succeeded in eliminating them so well that they are not perceptible even when the fork is struck moderately hard. This apparatus consists of an iron ring placed around the handle and soldered to the stem and base of the arms, and experiments have shown that when the ring satisfactorily covers the arch of the fork with the two nodal points, that the over-tones entirely disappear, even when the fork is struck quite hard, although at the same time it must be acknowledged that the intensity of the original, fundamental tone is considerably diminished. If now we file the ring away on both sides till the over-tones are just heard when the fork is struck with great force, we obtain at one and the same time greater intensity of the fundamental tone and an entire absence of over-tones when the fork is struck with considerable force only.

This T. F., if struck moderately hard, can be heard 90 seconds by A. C. in a normal ear, 24 seconds by B. C. from the

vertex, and then, after ceasing to sound, it can be heard for 42 additional seconds by A. C.

Unfortunately, we must not forget that the vibratory power, and particularly the presence of more or less intense over-tones in tuning-forks, are dependent not only upon the size and form of the fork, but that the material of which it is made takes a share in all these properties—the same thing as we learn in the construction of violins. It is this circumstance, too, which renders it impossible for us to construct forks that shall be precisely similar in tone, even when their dimensions are the same. A fork which greatly resembles those above mentioned, and which I used for out-patients, resonates about as long, but it is full of over-tones, a circumstance which is, in my opinion, due to excessive hardening of the steel. The results that I have obtained with this instrument vary wonderfully from those obtained with the previous fork, and particularly in that there are but very few cases in which it cannot be heard by A. C., and this, on the contrary, is something which frequently occurs when using the fork upon which I have relied since my investigations began.

This A tuning-fork weighs 860 grammes, the a<sup>1</sup> fork 60 grammes. The great weight of the former makes it disadvantageous for general use, but it has the advantage of showing great uniformity of results in a long series of cases. As we have already mentioned, the force with which the T. F. is pressed against the skull exerts considerable influence upon the duration of B. C.; the greater the pressure, *i. e.*, the more perfectly the handle remains in contact with the bone, the more unimpeded the escape of waves of sound through the bone, and the greater the rapidity with which the T. F. ceases to sound. This pressure, in the case of the larger forks, can be easily regulated by simply holding the handle perpendicular to the bony surface and letting its own weight hold the fork *in situ*. We can thus exclude a source of error which is so very common whenever we employ the a<sup>1</sup>, or other small tuning-forks, experimentally.

It is very difficult to arrange statistically the utility of Rinne's and other methods of testing the hearing with

forks. We know well enough, for instance, how defective is our foundation for the differential diagnosis between chronic diseases of the sound-conducting and sound-perceiving apparatus in all those cases in which, in the living, there was, on the one hand, a lack of positive symptoms on the part of the *Mt*, as well as of the contents of the tympanum, and on the other hand, of nervous symptoms or of any other points that could possibly be utilized in this direction. V. Troeltsch has frequently enough emphasized the necessity of caution in judging even enormous alterations in the *Mt*, so far as concerns our diagnosis of the disease that really causes the loss of hearing, and I myself have lately experienced this fact in making my examinations amongst young children in the common schools.<sup>1</sup>

If, therefore, we desire to obtain any binding conclusions from the results of Rinne's or any other T.-F. tests, we must not assume as our standard of comparison the generally accepted diagnostic points, as has been done in nearly all the statistical papers so far published on Rinne's experiment. If our standard is incorrect the answers from our patients and material will of course be untrustworthy and indecisive.

We may, however, proceed inversely, and in classifying our cases start *from the results of Rinne's experiment*, which at least in a large number of deaf persons shows such colossal variations, that errors on the part of the less intelligent persons can for these cases at least be excluded with moderate certainty. The uniform, positive result of Rinne's experiment in the natural ear justifies us in assuming that the remarkable variations from the normal observed in deaf persons are also due to the same purely physical causes within the ear as account for its uniform result in the normal ear.

In this respect we distinguish two well-defined groups, the one in which, despite a high degree of deafness in both ears, Rinne's experiment results about the same as in the normal ear, the other in which on both sides B. C. not only

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<sup>1</sup> These ARCHIVES, vol. xiv., pp. 158, 242.



lasts as long as A. C., but even longer to a greater or less degree. Owing to the influence exerted upon B. C. by the sound ear, we shall do well in our comparisons to exclude entirely those who are deaf on one side only, as well as those in whom Rinne's experiment results positively on one side, and negatively on the other, because they cannot help us to arrive at any correct decision.

If now we find that the other tuning-fork investigations in each of the different groups show a certain general agreement, and that, further, a larger number of peculiar symptoms recur in each with a certain regularity, we obtain, as I think, new and reliable proofs of the utility of Rinne's experiment.

This is the path that I have followed in collating the following tables, in which the result of Rinne's experiment whilst using the *a*<sup>1</sup> T. F. has served as a standard for classification.

In order to form some idea of the frequency with which this experiment gives us decisive results, I have included in the tables all of my private deaf patients during the first six months of 1886. Here we find all those cases in which with an intact *Mt* visual inspection and the use of the douche failed to show any reasonable cause for the deafness. I have excluded all cases of acute and subacute middle-ear catarrh, with well-pronounced tubal affection, and accumulation of secretion, as well as all cases recognizable as the sequel of otitis media purulenta; further, all extensive cicatrices and calcifications in the *Mt*,<sup>1</sup> and finally the cases of total unilateral deafness.

Some of the tables are unfortunately imperfect, so far as the details of the examination are concerned, partly because at first I did not pay sufficiently careful attention to all the various points, and partly because in some cases I postponed the rest of the examination to a subsequent visit, but was never able to complete it. Nevertheless I have no hesitation in publishing the series; for it will, at least, show how far Rinne's experiment can be universally utilized during

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<sup>1</sup>A portion of the latter are, for sake of comparison, contained in a following table.



a busy practice. If only once any given method has obtained citizenship in science, it is to be hoped that thereafter it will be more regularly carried out.

Rinne's experiment can be performed in the following method: The a<sup>1</sup> T. F., after being struck a moderate blow on one of the angles of its arms against a bit of soft wood is placed firmly upon the mastoid process just beneath the crista temporalis, but without touching the muscle, and the time in which it ceases to sound noted with a watch provided with a seconds-hand. The time is next to be measured as directed in Schwabach's<sup>1</sup> and Rohrer's paper,<sup>2</sup> in which the fork with the end of its arms directly in front of the concha reverberates still further by A. C., and this time in seconds to be noted as an expression of the positive results of the experiment. When the fork was not heard at all by A. C. after it had ceased to sound by the bone, I was not satisfied like most other observers, but I experimented inversely, first holding the fork in front of the ear after a moderate stroke, and then when it ceased to sound by A. C. I placed it on the mastoid process, and measured in seconds the time for which at this spot it continued to sound.

The latter duration cannot absolutely be compared with that discovered when Rinne's experiment results positively, because the T. F. placed upon the skull (or any other firm body) ceases to sound in less than half the time than by the air even when struck with equal force. Hence the values discovered in this inverse method ought to be doubled if they are to be compared as of equal value with those obtained when Rinne's experiment results positively. I. If, *e. g.*, the fork a<sup>1</sup> after ceasing to sound by A. C. is heard 10 seconds longer on the mastoid, the A. C. in comparison with B. C. is not only abbreviated by the 30 seconds by which the normal ear hears longer by the air than by the bone, but further by the additional 10 seconds during which it renews its sound from this new spot; but as the T. F. dies away here about one half quicker, the real difference between

<sup>1</sup> *L. c.*

<sup>2</sup> *Die Rinnesche Versuch, etc., Zuerich, 1885.*

this result and that obtained in the normal ear by Rinne's experiment amounts to at least  $30 + 2 \times 10 = 50$  seconds.

This reckoning has not been carried out in the tables, but the number of seconds simply noted by which A. C. surpassed B. C., or vice versa. In reality the differences are greater than are expressed by the values in seconds. I have nevertheless confined myself to these, as directly discovered, because on the one hand I had at command too small a series of measurements in the normal ear to be sure of the proportion which exists between the period of a T. F. vibrating freely in the air and one resting on firm bone, and on the other because the differences, even if we only consider the number of seconds, are large enough to enable us to exclude subjective errors and failures of observation, and thus to enable us to draw accurate diagnostic conclusions.

The experiment was also carried out in a similar manner with the large A fork, only B. C. was not measured from the mastoid process, but from the vertex, partly because it is harder to localize the tone of the large fork in *one* ear, and partly because when these experiments are carried out on the vertex, the pressure with which the A fork is applied is more easily regulated, for we simply let its own weight keep it in position.

Various abbreviations have been introduced into the tables and this paper, to show how Rinne's experiment results, and these demand some explanation. I should not like to replace the terms "positive" and "negative" with any abbreviations, and, as Politzer has suggested,<sup>1</sup> in order to avoid embarrassment I would rather choose for Weber's experiments other terms—*e. g.*, W. i. w. = Weber in worse, W. i. b. = Weber in better ear, because in this experiment there is no question of figures, as in Rinne's.

The number of seconds found in the latter represents the difference between the duration of A. C. and B. C. If we represent A. C. by *a* and B. C. by *b*, then  $a - b = x$ .

If A. C. lasts longer than B. C., as is always the case in

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<sup>1</sup> Rohrer: *Muenchener Med. Wochensch.*, No. 23, 1885.

the normal ear,  $x$  is a positive value, and, on the contrary, a negative value if B. C. lasts longer than A. C. If  $a$  and  $b$  measure precisely the same, *i. e.*, if the fork, after ceasing to sound on the bone, is no longer heard by A. C., or inversely, is no longer heard by the bone after it has ceased to sound by the air, then  $x = \pm 0$ .

If the fork is not heard at all by B. C., but only for a slight interval for A. C., then, in the above formula,  $b = 0$ , and  $x = +a$ .

If, on the contrary, there is no A. C. and B. C. measures no matter how many seconds, then  $a = 0$  and  $x = -b$ .

Finally, if there is neither A. C. nor B. C. for the fork, the difference between both is 0, and is so designated in the table.

If we leave aside the latter condition, which is quite exceptional, unless in cases of very slight capacity for hearing conversation, we can designate the various ways in which Rinne's experiment may result by  $+a + x \pm 0 - x - b$ , in which  $x$  denotes the number of seconds by which A. C. or B. C. predominates.

These terms are not intended to be mathematically exact; they simply represent easy abbreviations of practically attainable results, and as such they deserve to be generally acknowledged by the profession, like the long-accepted Snellen terms for acuteness of sight and the analogous abbreviations for the range of hearing suggested by Knapp and Prout; indeed, they are still more defective so far as accuracy is considered, because Hensen<sup>1</sup> has shown by experiments with three tuning-forks, that no fork ceases to sound with equality of diminution throughout, but that at a short time after being struck the sound ceases slowly, and then after a while it begins to die away with greater rapidity. Nevertheless, despite their imperfections, I should not like to be without the expression of our T.-F. investigations in figures, since they first interest us by their extremes, and secondly, only the strongly pronounced contrarieties which are thus shown are to be relied upon in drawing any conclu-

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<sup>1</sup> Hermann's *Physiologisches Hand-Buch*, Band iii., p. 120.

sions. Thus the table will often show at a glance how often the two extremes  $+a$  and  $-b$  are observed in testing with deep forks.

It will be difficult, I think, to find an audiometer which can be used with so great perfection as the deeper forks for the comparative testing of A. C. and B. C., and which shall cease to sound so evenly as these.

The following tables 1a and 1b contain all my private patients between January and July in whom there was total bilateral deafness without any essential alterations visible upon the *Mt*, nor to be discovered with the douche, and in whom Rinne's experiment with the  $a^1$  fork resulted *negatively*.

Column 3 contains the hearing for whispered voice in *cm*, but when this could not be distinguished close to the ear, or not at all, then the column shows the hearing for conversational voice.

Inasmuch as my investigations among 1,282 school-children,<sup>1</sup> in a space with a diagonal of 20 *M*. showed me how large a portion (207) could hear farther than this distance, whilst 146 could hear at least 19 *M*., and since this number grew smaller and smaller with each successive metre, the normal hearing for my whispered voice in *cm* can be regarded with Knapp and Prout as  $\frac{2000}{6000}$ , and each figure in column 3 is to be completed by adding the denominator 2,000 in case of a whisper, and of 6,000 in case of a conversational tone, as this can be heard about three times as far as a whisper. The same school investigations also showed that my whisper could be heard about as far as Politzer's audiometer, and for that reason I did not make any control-tests with that instrument, because we are much more interested in the comprehension of speech, and hence the use of speech as an audiometer with the above-mentioned cautions gives perfectly satisfactory results.

Column 4 contains in section *a* the result of Rinne's experiment with the  $a^1$  fork in seconds; column *b* (1) Weber's experiment, which, as it resulted better or worse, is so

<sup>1</sup> Schuluntersuchungen ueber das kindliche Gehoerorgan.

marked, or when the patient could not decide in which ear the tone was heard, it is marked "undecided," and (2) the time that the T. F. occupied in dying away on the vertex. The positive figures here indicate in seconds the time by which the patient heard it still longer on the vertex after I had ceased to hear it when placed in the same position on my head, and inversely the negative figures show the time by which I heard it longer by B. C. than did the patient.

Columns 5 *a* and *b* contain the results of Rinne's and Weber's experiments as tested by the large A fork, except that Rinne's experiment and the duration from the skull, were tested from the vertex instead of from the mastoid process.

Column 6 contains the limits in units and tenths of Galton's whistle perceived as a scream. The same instrument was employed in all the tests, one whose higher tone-limit measured by the normal ear amounted to 2.0 degrees on the register. It is difficult to express this precisely in tenths, because in the production of the tone it is impossible to know how forcibly the whistle is blown by pressure on the bag; with a strong puff a weak tone can be perceived so low as at 1.7. For this reason the bag should always be weakly pressed during these experiments.

I have further discovered by the aid of three of these whistles, that the upper limit of tone in one instrument does not always lie at the same place on the scale of other instruments, but differs by several tenths. It is therefore essential to fix in every instrument by means of normal ears the spot that corresponds to the upper limit of tone.

Inquiry was made in every case in regard to the presence of tinnitus, vertigo, heredity, and paracusis Willisii. The remaining columns need no further preliminary remarks.

Remarks.—The age of the 49 patients varied as follows: 3 between 10 and 19; 13 between 20 and 29; 19 between 30 and 39; 9 between 40 and 49; and 5 between 50 and 57.

Deafness had existed in 7 cases since youth, but in the majority of cases for several years. This type of disease consequently seems to be infrequent in infants, rather common in young persons, and generally beginning between 20 and 40 years of age.

TABLE 1a.—NEGATIVE RESULT OF  
BILATERAL AFFECTION

No.	Age.	Side.	Hearing for whisper and conversation in cm.	Tuning-fork a <sup>1</sup> .		Tuning-fork A.		Galton's whistle.	Condition of membrana tympani.	Subjective noises.
				a	b	a	b			
				Rinne, from mastoid.	Weber, and duration from vertex.	Rinne, from vertex.	Weber, and duration from vertex.			
1	14	R.	w 12	— 5	Undecided.	— 22		2.1	Both normal.	
		L.	w 12	— 6		— 20	+ 12	2.2		
2	33	R.	w 18	— 5	In worse.				Both normal.	Occasional knocking.
		L.	w 4	— 7	— 3				White limbus.	Occasional roaring.
3	30	R.	w 2	— 7	Undecided.					Constant roaring.
		L.	conv. 8	— 5	+ 3					
4	38	R.	w 8	— 5	Undecided.				Both normal.	
		L.	w 7	— 6	— 3					
5	17	R.	w 6	— 8	In worse.	— b	In worse.	2.3	Opacities in centre.	Occasional roaring.
		L.	w 8	— 8	+ 0	— 21	+ 12	2.3		
6	32	R.	w 18	— 8	In worse.	— 24	In worse.	1.9	Opacity in post. periphery.	Constant roaring.
		L.	w 6	— 8	+ 0	— b	+ 21	2.3	Opacities along ham- mer.	
7	57	R.	w 7	— 8	Undecided.				Normal.	Constant roaring.
		L.	w 6	— 9	+ 3				Normal.	

The rest of this table, cases 8 to 34, is omitted in the translation.

TABLE 1b.—NEGATIVE RESULT  
BILATERAL AFFEC-

No.	Age.	Side.	Hearing for whisper and conversation in cm.	Tuning-fork a <sup>1</sup> .		Tuning-fork A.		Galton's whistle.	Condition of membrana tympani.	Subjective noises.
				a	b	a	b			
				Rinne, from mastoid.	Weber, and duration from vertex.	Rinne, from vertex.	Weber, and duration from vertex.			
1	41	R.	w 3	— 5	Undecided.			2.5	Radiating opacities.	Occasional roaring.
		L.	w 3	— 4	+ 4			2.5		Constant roaring.
2	32	R.	w 5	— 5	In better.				Diffuse opacities.	
		L.	conv. 5	— 5	+ 0					
3	30	R.	w 5	— 5	Undecided.				Slight opacities.	Constant roaring.
		L.	w 12	— 6	+ 0					
4	31	R.	w 10	— 5	In better.	— b		3.0	Normal.	Occasional- ly like bells.
		L.	w 4	— 6	— 3			3.5		
5	56	R.	conv. 15	— 6	In better.	— b		4.5	Exostoses in meatus.	Occasional roaring.
		L.	conv. 3	— 6	— 5	— b		4.0		
6	25	R.	w 8	— 7	In worse.				Opacities.	
		L.	w 40	— 6	+ 0					
7	40	R.	w 12	— 6	Undecided.				Normal.	
		L.	w 25	— 5	+ 0					

The rest of this table, cases 8 to 15, is omitted.—TRANS.



RINNE'S EXPERIMENT.

IN WOMEN.

9	10	11	12	13	14
Disturbances of equilibrium.	Heredity.	Paracusis Willisiana.	Causation.	Duration.	Treatment and remarks.
Frequent attacks of vertigo.	Sister.		After salicylication. Since erysipelas. Worse after catarrh. After endometritis.	Several years. Eight years. One year. Three years.	Catheterism good and improves R to 20 and L to 30. Catheter increases R to 30. Catheter increases R to 4, L conv. to 15. Catheter improves R to 12, L to 9.
Attacks of vertigo.	Mother and two of father's sisters. Father.  Father.	Hears much better in a noise. Hears much better in the cars.		Three years.  Since childhood.  Eighteen years.	Catheter improves R to 8, L to 15. Catheter improved three years ago R, but not now; then, Rinne was + 10. Hears thunder poorly. Catheterization perfect.

OF RINNE'S EXPERIMENT.

IN MEN.

9	10	11	12	13	14
Disturbances of equilibrium.	Heredity.	Paracusis Willisiana.	Causation.	Duration.	Treatment and general remarks.
	Father.	Can hear on locomotive.	Rheumatism. Nervous symptoms.	Two years. Four years. Six months.	Catheter, but no improvement. Catheter. No improvement R. L, conversation at 8. Catheter improved L only to 18.
	Father.  Sister. Father and two brothers. Brother very deaf and defective in speech.			Several years. Many years. Eighteen months. Since youth.	No improvement by catheter, refractor, or pressure-probe. Catheter. No change L. R improved to 18. Catheter. R, 15. L to 50. Catheter and Lucae's pressure-probe of no avail.

The hearing amongst 98 ears was less than 20 *cm* for whisper in 74, and in 24 of the remaining only 4 times did it amount to 100 *cm* or over.

The result of Rinne's experiment in the 98 ears, with the fork *a'*, was 1, — *b* (with conversation at 3 *cm*).

12, — 10 to — 12.

82, — 3 and — 9.

3, + 0.

The result of Weber's experiment with the same fork was, in 49 persons, as follows :

12 times, undecided, owing to equal or nearly equal hearing of both ears ;

15 times in the worse ear ;

8 times in the better ear ;

5 times no notes were taken.

The duration of the perception of the *a'* fork from the vertex :

19 times coincided with mine ;

9 times surpassed it from 3 to 5 seconds ;

16 times was less than mine by from 2 to 6 seconds ;

4 times it was not measured.

Rinne's experiment with the A fork resulted, in 58 ears, as follows :

32 times — *b*, *i. e.*, the fork was not heard by A. C., but from the vertex ;

18 times between — 12, and — 25 ;

8 times — *x*, *i. e.*, the duration was not precisely noted.

Weber's experiment with the same A fork resulted, in the few cases examined, almost invariably, in favor of the worse ear.

The duration of the perception of the A fork from the vertex was compared with my own in 22 individuals ; 21 of them heard from 8 to 21 seconds longer than myself, whilst only one person, whose answers in other points were rather unreliable, heard it for a shorter time, and then by 12 seconds.

The upper perception of high tones, by Galton's whistle, resulted, in 64 ears, as follows :

27 times normal, and over-normal between 20 and 1.6 ;

37 times below normal between 2.1 and 4.5.

The membrana tympani in 98 cases was:

50 times normal;

27 times circumscribed opacities in various regions;

11 times diffuse opacities;

4 times slight diffuse rosy opacities;

2 times radiating stripes on the light spot;

1 time reflex behind short process;

1 time calcification of the anterior limiting tendon;

2 times exostoses in front of the short process, and furthermore, two dark spots on *Mt.*

Subjective noises were absent but 11 times in 49 individuals, 23 times they were constant, and 15 times occasional.

There was but one case in which the constant noise could be stopped by pressure upon the carotid. The noise most frequently resembled a roaring, yet some of the patients complained of hearing tones, the chirping of crickets, the ringing of bells, etc.

14 of the 49 complained of occasional attacks of vertigo, but generally without any especial characteristics; sometimes they were only noticed after blowing the nose, or closing the eyes, and no one ever completely resembled the Ménière's complex of symptoms.

Heredity was observed in 29 cases out of 49 patients; *i. e.*, in 59 %. And here we reckon only the progenitors and brothers or sisters. Of this number, 17 showed a single branch affected with deafness, and 4 three branches.

Paracusis Willisiana was observed 16 times; sometimes the patients informing us of this condition voluntarily, sometimes only when asked. This was noticed mostly, or most clearly, whilst on the cars.

Amongst the causes we cannot help noticing in women the coincidence of the deafness, or, at least, of a great decrease of hearing, with delivery, and this is shown by 5 cases out of 34. Nasal and naso-pharyngeal catarrh were not more frequent than in those with normal hearing. All of those cases were excluded in which there were within the ear any symptoms that might suggest an extension through the tube.

The process generally extends over years, and the hearing generally grew gradually worse, except in the childhood cases just mentioned, in which the decrease was rapid.

Air could generally be passed by the catheter into the middle ear without much, if any, difficulty, and the auscultation sound was generally normal. On one occasion upon using Delstanche's refracteur, it seemed as if the handle of the hammer moved imperfectly or not at all, but in all the other cases the hammer was perfectly mobile after rarefying the air in the meatus.

Thirty per cent. of the patients were men and 70 per cent. women.

Tables IIa and IIb show all of those *bilateral* affections with otherwise negative symptoms, in which Rinne's experiment was entirely or almost entirely positive with the a' fork, with little or no shortening.

Remarks—The patients were distributed according to age in this manner :

1 between 10 and 19; 1 between 20 and 29; 4 between 30 and 39; 7 between 40 and 49; 4 between 50 and 59; 5 between 60 and 69; 3 between 70 and 79; and 1 over 80.

The affection began 4 times in childhood.

The number of older patients here is remarkably greater than in the preceding tables, with negative result of Rinne's experiment.

The hearing in these 52 ears was 33 times less than 20 cm, and in the remaining 19 only 8 times greater than 100 cm for whisper. Most of the patients, therefore, show about the same hearing as those in table 1, and for this reason the totally different result of the tuning-fork tests is remarkable.

Rinne's experiment with the a' T. F. was :

10 times + a, *i.e.*, the T. F. was heard only by A. C., not at all from the mastoid process or vertex ;

18 times between + 30 and + 21 ;

20 times between + 20 and + 11 ;

3 times between + 10 and 0 ;

1 time + 0 (+ 27 on the opposite side).

Weber's experiment with the a' T. F. gave the following results :

6 times it was not heard from the vertex ;  
5 times it was undecided, because the hearing was alike,  
or nearly so, in each ear ;  
10 times the fork was heard in the better ear, and twice  
no notes of the result were preserved.

The  $a^1$  fork was heard for the following period from the  
vertex :

6 times not at all ;  
16 times shortened by from 2 to 6 seconds ;  
3 times + 0, *i. e.*, like my own, and it was not lengthened  
a single time.

Rinne's experiment with the A T. F. was tested in 32 cases:  
2 times it was neither heard by B. C. nor A. C., whilst the  
 $a^1$  fork was heard by A. C.

18 times the result was +  $a$ , *i. e.*, it was heard by A. C.,  
but not from the vertex ;

29 times it varied between + 53 and + 10 seconds ;  
2 times the duration was not measured, and  
1 time it was — 10.

Weber's experiments with the large fork A were mostly  
noticed in the better ear. This fork also was never length-  
ened from the vertex, but whenever its duration was  
measured, it was either shortened or not heard at all.

Galton's whistle was tested in 36 ears, and resulted :

19 times normal, 2.0 to 1.7 ;  
17 times less than normal, amongst these 5 times between  
5.0, and 10.5.

Case No. 7 showed tone-defects for the  $c^{iii}$  and  $f^{iv}$  sharp  
forks, whilst the  $c^{iv}$  sharp lying between was heard. Galton's  
whistle was heard at the normal limit by this patient about  
2.0, and no other defects in the scale could be discovered.

I would here remark that the patients of this group re-  
peatedly complained of sensitiveness to tones and noises,  
piano-playing, Galton's whistle, etc. Two of the patients  
(musicians) complained also of *false hearing* ; the former (an  
instrument maker) accidentally mentioned that with his right  
ear with conversational capacity of only 3 *cm*, and in whom  
Galton's whistle was only heard at 10.5, the tuning-forks A  
and  $a^1$  were perceived two octaves too high.

TABLE IIa.—POSITIVE RESULT OF RINNE'S EX.  
BILATERAL AFFEC.

1 No.	2 Age.	3 Side.	4 Hearing for whisper and conversation in cm.	5 Tuning-fork a <sup>1</sup> .		6 Tuning-fork A.		7 Galton's whistle.	8 Condition of membrana tympani.	9 Tinni us.
				a Rinne from mastoid.	b Weber, and duration from vertex.	a Rinne, from vertex.	b Weber, and duration from vertex.			
177	R. L.	w 4 w 4	+ 15 + 13	Undecided. — 5			2.7 2.0	Slight folds. Opacities.	Roaring like a river for 2 years.	
282	R. L.	w 3 conv. 60	+ 12 + 12	In better. — 5			2.0 9.0	Posterior opacifica- tion.	Constant roaring.	
354	R. L.	w 10 w 50	+ 16 + 17	Undecided. — 6	+ 20 + 22	In better. — 8	3.2 1.7	Narrow white limbus in both.		
438	R. L.	w 5 w 4	+ a + a	From vertex. o	+ a + a	From vertex. o	3.0 3.5	Diffuse opacity.	Noises from the start "like a crowd of people." Constant singing.	
557	R. L.	w 20 w 15	+ 18 + 14	— 6				Normal. Normal.		
633	R. L.	w 4. conv. 3	+ a + a	o From vertex.	+ a o	From vertex. o	2.0 2.0		Constant roaring from the start.	

NOTE.—Cases 6 to 23 omitted.—TRANS.

TABLE IIb.—POSITIVE RESULT OF  
BILATERAL AFFECTION

No.	Age.	Side.	Hearing for whisper and conversation in <i>cm.</i>	4		5		6	7	8
				Tuning-fork a <sup>1</sup> .		Tuning-fork A.				
				<i>a</i> Rinne from mastoid.	<i>b</i> Weber, and duration from vertex.	<i>a</i> Rinne from vertex.	<i>b</i> Weber, and duration from vertex.			
1	49	R.	w 60	+ 28	Undecided.				Opacity in anterior superior quadrant.	Constant roaring. Right.
		L.	w 300	+ 26	+ <sub>0</sub>					
2	61	R.	w 100	+ 26	in better	+ a	from vertex.	2.0	Normal.	Intermit- tent roaring in both ears.
		L.	w 20	+ 16	— 4	+ a	o	2.0	Normal.	
3	76	R.	w 3	+ a	o	+ 19		2.2	Circumscribed opacities in periphery.	Constant noises, <i>e. g.</i> : trumpets, bells, etc.
		L.	w 3	+ 25	from vertex.	+ 21	— 10	2.3		



PERIMENT, WITH LITTLE OR NO SHORTENING.  
TION IN MEN.

9	10	11	12	13	14
Disturbances of equilibrium.	Heredity.	Paracusis Willisiana.	Causation.	Duration.	Treatment and remarks.
Occasional short attack of dizziness forward.			Working near a large steam hammer.	Several years.	No improvement after catheter.
				2 years.	No improvement by catheter; gradually grew worse.
				3 years.	Catheterization faint, no change L for 2 years; decrease R sensitive to loud noises.
For first six months constant vertigo with occasional emesis. Frequent vertigo.			Syphilis twenty years before; inunction cure.	2 years.	Catheter improves R to 10, L to 5. The a <sup>11</sup> fork heard only by A. C. not by B. C. at all.
				15 months.	No improvement by catheter nor by potassic iodide; decreased one half in one year.
Vertigo for two years; within the last fortnight worse.				2 years.	Catheter of no use. Pilocarpine treatment.

RINNE'S EXPERIMENT, WITH LITTLE OR NO SHORTENING.  
IN WOMEN.

9	10	11	12	13	14
Disturbances of equilibrium.	Heredity.	Paracusis Willisiana.	Causation.	Duration.	Treatment and remarks.
Vertigo on bending over.	Mother and mother's father deaf.			Four months.	
Frequent characteristic attacks of vertigo with repeated vomiting.				Two years.	Worse before vertigo; once reduced both ears to 25. After pilocarpine, 2½ months, R 150, L 35. Sensitiveness to tones and occasional false hearing.
				For many years.	Catheter L to 8. Five weeks later R 4, L 6.

The membrana tympani in 52 cases was :

26 times normal ;

15 times with circumscribed opacities, 7 of which were posterior, and once there was a trace of folds ;

10 times with diffuse opacities, amongst these one trace of folds and vascular injection ;

1 time, exostosis in front of the short process.

Subjective noises were absent 7 times, 15 times constant, and 4 times occasional. They were more varied than in the previous tables, their initial stage more accurately fixed, and many times they could be attributed to a definite cause, like a detonation, for instance, to which the ear had been exposed. The tinnitus is often noticed as an associated symptom, with a violent attack of vertigo, and for that reason clings vividly to the patient's memory.

Disturbances of equilibrium were present 14 times in 26 patients, and of these 5 cases were severe, characteristic, repeated, and greatly resembling Ménière's complex ; the remaining 9 cases were less severe, rarely noticed except on leaving the bed in the morning, or on bending over, looking up to the sky, etc. The tinnitus and hearing did not always grow worse at the incipency of an attack of vertigo, but, on the contrary, it was repeatedly noticed that a successive decrease of hearing and increase in the subjective noises generally preceded an attack of vertigo by several days, whilst at the appearance of a severe and characteristic attack of vertigo, with vomiting, etc., the hearing improved, and the tinnitus decreased rapidly.

Heredity is but sparsely noted in this group. In 26 patients there were 4 cases of this influence : once single, once double, once threefold, and once sixfold (2 aunts, 2 brothers, and 2 sisters).

Paracusis was discovered but once.

Amongst the causes of the deafness, etc., we find syphilis noted three times. Six of the twenty-three men are zealous marksmen, have practised a great deal in closed rooms, and these complained of the extreme reverberation within this space. Three of the men referred the beginning of their attack of deafness to a detonation. Amongst the

other patients were two who work at the steam hammer in a large manufactory, where it is notorious that all grow deaf who have any work to do near this machine. One patient ascribed his deafness to extreme mental exertion, working many hours daily over finance, and late into the night over theoretical studies.

The course and treatment of this group show many interesting points. The patients often mention the sudden beginning with disturbances of equilibrium and subjective noises. Several cases exhibited great variations, not only in the subjective symptoms, vertigo and roaring, but in the hearing, which often rapidly decreased; and then again, frequently after characteristic Ménière's complex, it would as rapidly increase, and almost invariably to an astonishing degree. Such startling alterations in hearing as these were never observed in patients belonging to Tables I and Ia. I venture all the less to decide whether this rapid return of function in these cases is to be regarded as due to the use of potassic iodide, pilocarpine, etc., since, in a colleague whom I once examined before these tables were begun, I had a chance to learn by experience that such rapid changes can occur in this form of disease without any interference on our part. This man had been moderately deaf for years, and had repeatedly suffered from attacks of Ménière's symptoms. When I saw him again his hearing had rather suddenly decreased to so great an amount that he could only hear conversational speech close to the ear; nevertheless, Rinne's experiment resulted positively; there were no inflammatory symptoms, and Ménière's symptoms were entirely absent. A proposed pilocarpine treatment was, for good reasons, postponed. When I accidentally examined the patient, a week later, his hearing had increased in the right ear from 8 *cm* for whispered voice to 2 metres, and that without any treatment at all.

In regard to the pilocarpine treatment, as suggested by Politzer, I would say that, so far, I have had such favorable results that I am prompted to continue still further my investigations with this remedy, and especially in fresh cases.

The two sexes are more disproportionally divided in

these than in the previous tables, since here, in tables II and IIa, we find 89 per cent. men and only 11 per cent. women.

Although there are so few patients in tables II and IIa yet they deserve to be used statistically, because they show *all* the cases with these complex of symptoms that came under my notice within the space of six months. As I remarked above, I have excluded all acute and sub-acute forms, all forms with noticeable pathological alterations in the *Mt*, and those discoverable by the air douche (liquids), also all pronounced concavities of the *Mt*, and collections of secretion within the tympanum, all distinctly recognizable cicatrices of the *Mt*, and finally all cases of unilateral deafness.

Further omissions from the tables included all *bilateral* diseases in which Rinne's experiment was positive on both sides, but decidedly abbreviated in comparison with the amount of hearing, as well as those in which the same experiment resulted positive on one side and negative on the other, and all *unilateral* forms of deafness, no matter whether Rinne's experiment resulted positively or negatively. Affections of the first sort fail, with Rinne's test, to give accurate results for the differential diagnosis between diseases of the middle and inner ear; these are the cases which I collected under the title of "dysacusis" in my previous reports. With unilateral deafness we cannot exclude B. C. into the healthy ear from the mastoid, if we use the small fork, or even from the vertex if we use the large A fork. This is the reason, at least in high degrees of unilateral deafness, why, despite a perfect condition of the sound-conducting apparatus, A. C. is exceeded by B. C.; the latter appertains partly to the healthy ear. Rinne's experiment can, consequently, in these cases, result negatively, even in purely nervous affections. Both groups would simply have obscured the perfect picture which the bilateral affections alone are able to offer us when Rinne's experiment results either decidedly positive or decidedly negative; and for that reason they will be found further along by themselves.

The cases in the first two tables offer frequently recurring

peculiarities, not only in their relation to Rinne's experiment, but in their entire series of symptoms; a partially different set of symptoms is to be found with the same frequency in the second set of tables. The distinction between the morbid picture of the two groups can best be seen by arraying their principal symptoms in antagonistic columns.

TABLES Ia AND Ib.

Rinne's experiment with the  $a^1$  fork is *negative* in every case.

The preponderance of B. C. over A. C. is still more marked in testing Rinne's experiment with the A fork, which, in 32 cases out of 58, was not heard at all by A. C.

Weber's experiment, when applicable with the  $a^1$  fork, was heard almost twice as often in the *worse* ear as in the better, whilst with the A fork, it was referred almost exclusively to the worse ear.

In a portion of the cases, the duration of B. C. for the  $a^1$  fork from the vertex was greater than mine, but in a somewhat larger portion it was less. With the A fork the excess was much more marked, except in a *single person*.

The upper tone-limit (measured by Galton's whistle) was in more than half of the cases beneath the normal, but at the maximum it was only 4.5 removed from the normal limits.

Subjective noises were present in 77 per cent. ; they were constant more than twice as often as occasional.

Disturbances of equilibrium, mostly of a moderate degree, were announced in 29 per. cent. of the cases.

Heredity was observed in 59 per cent.

Paracusis Willisiana was mentioned in 32 per cent.

TABLES IIa AND IIb.

Rinne's experiment with  $a^1$ , *positive* in every case, and lasts quite long.

With a single exception, Rinne's experiment with A is positive in every case, and much more decidedly so than with  $a^1$ . In 18 cases out of 32 A was not heard by B. C.

Weber's experiment with  $a^1$  heard three times as often in the *better* than in worse ear, but with A it was exclusively referred to the better ear.

The period of perception for  $a^1$  fork was never lengthened, frequently abbreviated, and six times it was 0. A was shortened in every case from the vertex or elsewhere.

The upper tone-limit was less than in one half below the normal; but rather frequently shortened to a considerable degree (10.5). Two cases of false hearing with forks are mentioned.

Subjective noises were present in 73 per cent. ; they were nearly four times as often constant as occasional.

Disturbances of equilibrium were present in 53 per cent. and Ménière's complex of symptoms present in more than one third of the cases.

Heredity was observed in 15 per cent.

Paracusis Willisiana was mentioned by one patient only (3.8 per cent.).

Childbed plays the most important ætiological part in women.

The course of the disease, with the exception of the childbed cases, is characterized by an even and gradual decrease of hearing.

Children are seldom affected.

Most of the patients are between 20 and 40 years of age.

Men are represented by 31 per cent., women by 69 per cent.

The chief causes are exposure to loud and sudden noises, syphilis, and mental overwork.

The disease may begin suddenly with Ménière's symptoms, sudden relapses, and as sudden improvement of the hearing.

Children are seldom affected.

Most of the patients are over 40, and a large number between 60 and 80.

Men are represented by 89 per cent., women by 11 per cent.

Thus we see the contrarieties of the two groups. The symptoms of the first group correspond, as a whole, to those in middle-ear diseases, those of the second to diseases beyond the middle ear. This classification brings out some new differential diagnostic points, and chiefly, too, in opposition to former views, the excessive preponderance of heredity in diseases of the sound-conducting apparatus in comparison with nervous affections, and the enormous difference between the proportions in the two sexes. The latter point will be easily comprehended when we reflect upon the ætiology, and see on the one side childbed, and on the other the deafening of the ear by shooting, and a variety of handicrafts, syphilis, and mental overwork.

It is well worth noticing that all of these conditions are well represented, though not quite so forcibly, in my 1881-1883 tables,<sup>1</sup> whilst at that very time I had placed my chief reliance for a differential diagnosis between diseases of the middle and inner ear on the results of Rinne's experiment with the *a*<sup>1</sup> fork.

If we start from the explanation which I have given for the negative result of Rinne's experiment in diseases of the middle ear, viz., that in a majority of these we are to search for the cause of the preponderance of B. C. in an increased tension of the conducting apparatus at its most important point, the *ligamentum annulare*, we may expect to find, as I have presupposed, that those cases of dry sclerosing processes, as shown in Tables Ia and Ib, will show, in their

<sup>1</sup> ARCHIV. F. O., xxi., p. 221.



behavior under the tuning-fork tests, the greatest analogy amongst the affections of the middle ear, with those more or less chronic suppurative conditions of the middle ear, and their sequelæ. Indeed, it is probable that in the latter the proportion between A.C. and B.C. will reveal itself much more forcibly in favor of B.C. than is the case in otitis media simplex chronica sclerotica, because we plainly witness not only a more extensive and epidermoidal transformation and rigidity of the mucous membrane which lines the entire sound-conducting apparatus, but this apparatus is still further disorganized by other pathological alterations. For leaving aside the frequent presence of pathological adhesions at various localities, and of anchyloses in the articulations of the ossicles, every loss of radiating fibres, every perforation of the *Mt* must signify some disturbance in the unstable equilibrium, which so suits the normal apparatus for the reception of waves of sound, and, on the contrary, renders it less suitable for B.C., for the simple reason that in this way the tensor tympani obtains over the stapedius a preponderance that increases with the size of the perforation, and so presses the end of the chain of ossicles inward. This unstable equilibrium will be totally disturbed when portions of the chain, *e. g.*, the anvil, are entirely lost, and when the stapes is isolated, and often remains without even the tendon of the stapedius; the preceding processes in such cases, owing to their great severity, can be suspected with great probability, and further, that the fixation of the isolated stapes has become much stiffer from adhesions of one of its limbs and thickening processes at the ligamentum annulare.

When, therefore, with extensive and visible disturbances at the conducting chain, the tuning-fork tests, and especially Rinne's experiment, offer us the same results as were found in Tables Ia and Ib in diseases with negative condition, so far as our present means of investigation are concerned, we are justified in drawing the conclusion that in the latter also, in some spot inaccessible to our investigations, a pathological fixation of the sound-conducting apparatus must be present.

For the purpose, therefore, of comparison with the tables already preceding, I here offer a further table, constructed in the same fashion, to show the results of tuning-fork investigations in a series of sequelæ to middle-ear suppuration. This contains a portion of the cases that I saw in the first six months of 1886; I picked out those in which the suppuration had nearly or entirely ceased, and in which the extent of the destruction was particularly open to inspection. Most of the cases were, as in the former table, bilateral.

## III.

In these 36 ears, belonging to 10 men and 8 women, there were 26 large defects in the *Mt*: three times the *Mt* and handle of the malleus were entirely absent; three times there was nothing left but a stump of the handle of the malleus and the *Mt* attached to it; five times the incudo-stapedial articulation with the long arm of the anvil was apparently intact, partly free, and partly enclosed in cicatricial tissue; once the same was visible, but with the long arm of the anvil dislocated; further, there were 5 cases of isolated head of the stapes, with loss of the long

TABLE III.—PERSISTENT PERFORATIONS AND CICA-

No.	Age.	Side.	3 Hearing for whisper and conversation.	4 Tuning-fork a <sup>1</sup> .		5 Tuning-fork A.		6 Galton's whistle.	7 Condition of membrana tympani.
				a	b	a	b		
				Rinne from mastoid.	Weber, and duration from vertex.	Rinne from vertex.	Weber, and duration from vertex.		
1	19	R.	J w 10   C 400	— 5	Undecided.		Undecided.	2.0	Total defect, except handle of ham- mer ; stapes isolated in both.
		L.	w 9 C 300	— 5	+ 5			2.0	
2	22	R.	w 35	+ 0	+ 3	— a	+ 14	2.1	Defect of post quadrant.
		L.	w 25	— 3		— a		2.1	Defect of inferior half.
3	30	R.	w 150	+ 0	in worse.	— 8	+ 0		Cicatrix in post. half.
		L.	w 100	+ 0	+ 0	— 9			Defect of post. inf. quadra.
4	24	R.	w 20	+ 0	in worse.	— a	+ 13		Defect of post. half.
		L.	w 500	+ 25	+ 3				Normal L.
5	14	R.	w 500	+ 23	+ 6	— 13			Normal R.
		L.	w 30	+ 7					Left : large defect in front of umbo. Calcification in anterior and in- ferior half.

Cases 6 to 18 omitted.—TRANS.

arm of the anvil; amongst them one where the tendon of the stapedius was also lost; 5 times the stapes was no longer visible, despite the fact that we could plainly overlook the posterior superior quadrant of the tympanum. There was a slight trace of suppuration still visible in 9 out of 26 ears.

The table also includes 6 cases of former suppuration, with extensive cicatrization in the *Mt*. In 2 of these the incudo-stapedial ligament was enclosed in the cicatrix, and in one the isolated head of the stapes.

In 4 cases, finally, the *Mt* and hearing on the other side were normal, or nearly so.

The hearing (leaving aside these 4 last cases) in 32 ears was 14 times less than 20 *Cm*, and in the remaining 18, 11 between 20 and 80, 6 between 100 and 200, 1 despite a large cicatrix, 5 for whisper.

Despite the frequent greater hearing-average of this group, in comparison with that included in tables *Ia* and *Ib*, Rinne's experiment with the *a'* fork was *negative* in every case but three, and the hearing in these was for whisper, once 30, once 150, and once 500.

TRICES IN MT AFTER OTITIS MEDIA PURULENTA.

8	9	10	11	12
Tinnitus.	Disturbances of equilibrium.	Causation.	Duration.	Duration of otorrhœa. Treatment and remarks.
Plashing sound on touching head of stapes.		Diphtheritis.	Ten years.	Insufflation of boric - acid powder improved R to 30. L not improved. Dry perforation sound R.
R constant roaring.		Scarlatina.	Seventeen years.	Otorrhœa two and a half years. Mucosa yellowish. Both ears dry, perforation sound. Politzer's experiment pushes cicatrix forward and w 350, and Rinne with $a^1 + 10$ . Otorrhœa still persistent though slight.
Previously constant roaring.		Otorrhœa since removal of a bean.	Since youth.	
		Fourteen days since a relapse after bathing.	Seven years.	The suppuration ceased eighteen months ago after antiseptic treatment.

To tabulate, we have as follows:

- 1 time — a (hearing for conversation 2);
- 6 times between — 10 and — 12;
- 16 times between — 3 and — 8;
- 6 times + 0 (with hearing for whisper of 20, 35, 50, 100, 150, and 200 *Cm*).

Weber's experiment with the small *a'* fork was 4 times undecided (amongst these 3 with nearly or the same hearing);

- 11 times in the worse ear, and only once in the better ear;
- 2 times there were no notes taken.

The duration for perception of T. F. *a'* from the vertex resulted:

- 3 times in consonance with mine;
- 11 times it surpassed mine by 3-8 seconds;
- 1 time (in a man of 56, with conversational hearing of 5 *Cm* on both sides) it was 3 seconds less than mine;
- 3 times notes are lacking on this point.

Rinne's experiment with the large A fork was tested on 30 ears, and resulted only:

- 1 time positive, as did the same experiment with the small *a'* fork (this was the case with incudo-stapedial articulation enclosed in a cicatrix);

17 times — a, and

12 times between — 7 and — 28 seconds.

Weber's experiment with the A fork was heard 4 times in the worse ear; 4 times it was undecided, and there are no notes in the remaining cases.

The time for which the large fork was heard from the vertex in 15 cases was once equal to mine, 13 times elongated by from 5 to 21 seconds, and only once shortened, and then by 8 seconds, and in the same case as the *a'* fork.

Galton's whistle was used 18 times, the upper tone-limit being reached and surpassed 8 times, and not reached 10 times. Two of the latter cases showed tone-gaps lying between 7 and 5, and 9 and 8 of Galton's scale.

If we compare the results of tuning-fork tests in persistent perforations and cicatrices of the *Mt* with those in Tables *Ia* and *Ib*, we find as perfect an agreement between

the two as we could on the whole expect from a method in which we must rely upon the subjective observation of the patient.

*The result of this comparison is that we gain powerful support for our theory that in every case in which Rinne's experiment results negative (except in cases of excessive difference between the hearing of the two ears) there must exist some mechanical affection of the sound-conducting apparatus, which in some way or other disturbs its unstable equilibrium.*

And, finally, the diagnostic importance of the negative result of Rinne's experiment in its bearing upon the presence of fixation of the conducting apparatus, especially of the stapes, has been anatomically confirmed by post-mortem examinations at the hands of Lucae,<sup>1</sup> Politzer,<sup>2</sup> Habermann,<sup>3</sup> and myself.<sup>4</sup>

In order to exhibit in full the results of Rinne's experiments, I excluded from the first two tables all cases of unilateral deafness, no matter whether they resulted positively or negatively. But I now subjoin them in separate tables for sake of comparison.

The number of these cases is too small to use them statistically.

We at once take it for granted that in unilateral affections those very points of support which the negative result especially gives are less reliable than in bilateral diseases. When the hearing of one ear is greatly reduced the bone-conduction of the healthy side, which cannot be excluded, especially when we test the diseased ear with the A fork, must preponderate over the remnant of A. C. in the latter, despite the presence of a nervous type of disease.

This we probably see in cases 2 and 3 in Table IV., as we may conclude from the symptoms there arrayed.

On the contrary in the remaining patients of this table, the condition seem to indicate an affection of the middle ear.

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<sup>1</sup> *Archiv f. O.*, Band xxiii., page 122.

<sup>2</sup> Siebenter Vers. Sueddeut. und Schw. Aertze.

<sup>3</sup> *Zeitschrift f. Heilkunde*, Band vii., page 361.

<sup>4</sup> Erklarungsversuch zum Verhalten der Luft- und Knochenleitung beim Rinne's V. Muenchen, 1885.

TABLE IV.—NEGATIVE RESULT OF RINNE'S

a. IN

No.	Age.	Side.	Hearing for whisper and conversation.	Tuning-fork a <sup>1</sup> .		Condition of membrana tympani.	Subjective noises.
				a Rinne from mastoid.	b Weber, and duration from vertex.		
1	27	R. L.	w 500 L 10	+25 -4	In worse. + <sub>o</sub>	Normal.	Occasional roaring.
2	39	R. L.	w 500 w 6	+23 - <sub>o</sub>	In better. + <sub>o</sub>	Normal.	Constant roaring and blustering.
3	50	R.	w 500 w uncertain.	-7	In better.	Normal.	Occasional roar- ing when ex- cited.

b. IN

1	24	R. L.	w 500 w 3	+17 -6	In better. + <sub>o</sub>	Normal.	
2	27	R. L.	w 500 w 175	-28 - <sub>o</sub>	In worse.	Normal.	Occasional roaring.
3	44	R. L.	w 8 w 500	-10 +21	In worse.	Normal.	Constant roaring.

TABLE V.—POSITIVE RESULT OF RINNE'S

IN MEN

No.	Age.	Side.	Hearing for whisper and conversation.	Tuning-fork a <sup>1</sup> .		Condition of membrana tympani.	Tinnitus.
				a Rinne from mastoid.	b Weber, and duration from vertex.		
1	52	R. L.	w 100 w 500	+22 +24	+ <sub>o</sub>	Normal.	Constant roaring and singing of birds.
2	34	R. L.	w 500 w doubtful.	+29 +10	In better. + <sub>o</sub>	Exostoses in meatus.	Constant roaring.
3	39	R. L.	w 500 w 200	+22 +22	In better.	Normal.	Constant roaring.
4	52	R. L.	w 500 w 80	+29 +21	Undecided. + <sub>o</sub>	Normal.	
5	11	R. L.	w 6 w 500	+19 +25	In worse. + <sub>o</sub>	Slight injection.	
6	38	R. L.	w 500 w 175	+33 +27	Undecided. + <sub>o</sub>	Slight striated opacities.	Occasional tinnitus.
7	53	R. L.	w 200 w 500	+14 +35	In better. + <sub>o</sub>	Normal.	Occasional tinnitus.
8	31	R. L.	w 500 w 30	+22 +19	- <sub>o</sub>		Normal.



EXPERIMENT, UNILATERAL AFFECTIONS.

MEN.

7	8	9	10	11
Disturbances of equilibrium.	Heredity.	Causation.	Duration.	Treatment and remarks.
Characteristic attacks of vertigo; falls in street, and invariably vomits. Begins with characteristic vertigo and emesis.	Father's brother very deaf in old age.	A great deal of headache in frontal region.  Valvular heart disease after rheumatism; sudden deafness and roaring.	Four years.	Catheter of no use. Deistanche's instrument does not move hammer. Lucæ's pressure probe improves L to 18.
			Nine years.	Catheter does not improve. Hearing increased to 70 under potassic iodide. All forks heard higher. Galton's whistle 2.1 in both ears.
			Nine months.	All forks heard L by A. C. Galton's whistle 5.5.

WOMEN.

	Father deaf in old age.		Four years.	A from vertex + 10 and Rinne with A - a.
		Began during pregnancy. Increase of tinnitus during menses. Migraine.	Two and a half years.	Catheter improves L to 350.
	Mother deaf in old age.		Nine years.	Catheter bulges <i>Mt</i> . Paracentesis showed tympanum empty and normal. Successive decrease of hearing from 300 to 8. Galton's whistle R 4.2, L 2.0.

EXPERIMENT IN UNILATERAL AFFECTIONS.

EXCLUSIVELY.

7	8	9	10	11
Disturbances of equilibrium.	Heredity.	Causation.	Duration.	Treatment and remarks.
Frequent vertigo with emesis.		Transitory deafness from gunning two years before. Is obliged to shoot a great deal.	Six months.	Catheter increases R to 300.
		A great target shooter. Overworks a great deal. Great sexual indulgence.	Many years.	No improvement with catheter.
Slight vertigo.			One year.	Catheter improves the tinnitus a trifle. Rinne's experiment with A L + 26. Galton's whistle 2.0. After Politzer's bag R 20.
			Six months.	Catheter R 200.
			One year.	Catheter with large stream increases R to 250. Six months later 125 R.

Conversely, case 7 Table V. must be one of middle-ear disease despite the positive result of tests with the  $a^1$  fork, because with a hearing of 200 for whisper, the experiment although not negative, is yet abbreviated to  $+ 14$  in comparison with  $+ 35$  on the other side, and the same test with the large A fork when hearing had decreased to 125 for whisper showed  $- a$ . When the deafness is more advanced the test with  $a^1$  also will result negatively. I have at least been able to confirm an analogous condition in several progressive cases in which, when the hearing was formerly better, Rinne's experiment resulted shortened but positive, whilst later with increased deafness it resulted negatively. We find, *e. g.*, four cases of this in the first table. And in these with successive gradual decrease of the hearing, and the same gradual decrease in the length of the positive result of Rinne's test until it is so finely transformed to the negative side, I see new confirmation of its diagnostic reliability.

Inversely, with tubal affections accompanied with heavy unilateral clogging of the chain of bones, and high degree of deafness, we obtain a positive result the moment that the hearing is restored, whilst at the height of the affection the experiment is emphatically negative.

In case 2 Table V., in spite of the great reduction of Rinne's experiment upon the affected side to  $+ 10$ , in comparison with  $+ 29$  on the other, yet considering the simultaneous great degree of deafness (whisper doubtful), I should urge the presence of an affection beyond the middle ear, and, indeed, the man's occupation as a hunter, and the characteristic attacks of vertigo with vomiting, would be additional objective symptoms to favor this theory.

Tables VI*a* and VI*b*, which follow, contain bilateral affections with shortened bilateral or negative unilateral result of Rinne's experiment with the  $a^1$  fork, which were excluded from previous tables.

It is difficult in these cases to base any accurate diagnosis upon the result of the comparative tests between A. C. and B. C., and if we had nothing further to help us in our decision, as it is often enough the case, we should be obliged to fall

back on the term "*dysacusis*." A greater portion of the cases probably belong to an early stage of affections of the sound-conducting apparatus, like those above cited, in which, at a later investigation, the negative result of Rinne's experiment confirmed the truth of the diagnosis. In others there probably exists a complication between an affection of the middle and inner ear.

There is one fact which we discover in *acute and subacute inflammations of the middle ear* that appears to weigh heavily against the diagnostic value of Rinne's experiment; viz.: that in these most marked forms of inflammation of the middle ear, especially in *otitis media purulenta acuta*, we obtain, despite well-marked diminution of the hearing, an abbreviated positive result. Politzer discovered the same phenomenon. This was my reason for excluding all cases of this sort, both acute and subacute from consideration, provided we wish to obtain any accurate information concerning the result of the experiment in simple rigidity of the sound-conducting apparatus. It was only in this way that the desired accuracy in regard to its diagnostic importance could be obtained.

It is at present difficult to find any satisfactory explanation for this extremely different condition of some of the acute and subacute diseases.

It is possible that the acute suppurations of the middle ear with diminution of hearing for whisper and occasionally total loss for loud speech are simultaneously accompanied with an excessive inflammatory condition of the labyrinth, something like the small-celled infiltration confirmed by Moos in various acute infectious diseases.

It is also credible, on the contrary, that a serous infiltration of the mucous membrane, of the articulations, of the entire *Mt*, and of the ligamentum annulare exerts another, and perhaps an entirely opposite influence upon the mechanism of the conducting apparatus, than the simple but stiffer fixation, such as we have a right to suspect in the chronic sclerotic processes. Soaking with fluid might produce relaxation instead of tension, whereupon two forces would be working simultaneously and antagonistically upon the sound-conducting apparatus—upon one side the succu-

TABLE VIa.—BILATERAL SHORTENED OR ONLY UNI.  
BILATERAL AFFECTION

No.	Age.	Side.	Hearing for whisper and conversation.	4 Tuning-fork a.		5 Condition of membrana tympani.	6 Subjective noises.
				a Rinne from mastoid.	b Weber and its duration from vertex.		
1	63	R. L.	w 450 w 200	+ 27 + 8	In worse. + 0	Normal.	
2	62	R. L.	w 150 w 10	+ 25 + 12	Undecided. + 0	Normal.	Constant roaring.
3	28	R. L.	w 300 w 30	+ 28 - 3	Undecided.	Normal.	Constant roaring.
4	40	R. L.	w uncertain. w 250	- 8 + 28	Undecided.	Slight folds.	Constant roaring.
5	16	R. L.	w 30 w 300	- 7 + 7	In worse.	Normal.	
6	49	R. L.	w 3 w 400	- 7 + 23	In worse. - 3	Without any light spot.	
7	48	R. L.	w uncertain. w 250	- 10 + 21	In worse. + 0	Slightly opaque poste- riorly.	Roaring of late.

TABLE VIb.—BILATERAL SHORTENED OR ONLY UNI.  
BILATERAL AFFECTION

No.	Age.	Side.	Hearing for whisper and conversation.	4 Tuning-fork a <sup>1</sup> .		5 Galton's whistle.	6 Condition of membrana tympani.
				a Rinne from mastoid.	b Weber, and duration from vertex.		
1	31	R. L.	w 100 w 10	+ 12 + 12	+ 0		Normal. Calcification in post. and lower half. Slight opacities.
2	47	R. L.	w 25 w 35	+ 14 + 14	In worse. - 5	2.0 2.0	
3	33	R. L.	w 7 w 3	+ 9 + 9	0	2.0 2.0	Slight circumscribed opacities in post. sub-quadrant.
4	27	R. L.	w 200 L 250	+ 19 + 17	- 5	2.0	Normal.
5	37	R. L.	w 50 w 60	+ 18 + 16	In worse. - 4	2.0	Normal.
6	63	R.	conv. uncertain.	- 10	In worse.	2.4	Normal.
7	58	L. R. L.	w 18 w 20 conv 5	+ 20 + 18 - 12	- 3 In better. + 0	2.2	Posterior opacities.

Cases 8 to 11 omitted.

LATERAL NEGATIVE RESULT OF RINNE'S EXPERIMENT.

IN MEN.

7	8	9	10	11
Disturbances of equilibrium.	Heredity.	Causation.	Duration.	Treatment and remarks.
	Father deaf.		Several years.	No improvement by catheter.
			Several years.	Catheter improves R to 450, L to 12, slight decrease in last two years.
		Coppersmith. Roaring began seven months ago while at the steam hammer. Deafness after a musket was fired close beside him.	Four years.	No improvement by catheter.
	Sister, brother, father, and father's mother deaf.		Several years.	Successive decrease in four years to R 15, L 50.
2 years ago vertigo.			One year.	Rinne's experiment with A, R—a.
			Several years.	No improvement by catheter.

LATERAL NEGATIVE RESULT OF RINNE'S EXPERIMENT.

IN WOMEN ONLY.

7	8	9	10	11	12
Tinnitus.	Disturbances of equilibrium.	Heredity.	Causation.	Duration.	Treatment and remarks.
Occasional roaring.	Occasional vertigo.	Mother deaf.	Much worse after chloroform narcosis for an operation.	Three months. Since childhood.	No improvement with catheter.
Constant roaring and drumming.			Sudden occurrence after being obliged to work after delivery.	Fourteen days.	No improvement with catheter. Much worse despite iodide and pilocarpine, and in four months conversation L at 8.
Occasional roaring.	Previously there were characteristic attacks of vertigo.			For years.	No improvement with catheter.
R constant roaring. L rapidly intermitting noises.		Brother and niece deaf.		Thirteen years.	
Constant roaring.		Father and grandfather deaf in old age.		Several years.	Catheter does not improve. Three years later gradual decrease.
Constant roaring.				Thirteen years.	Catheter improves R to 35. Two years later 15 only.

lence of the tissue, on the other, the unilateral clogging down of the *Mt* by the closure of the tube, which is here almost always present under such circumstances.

Both of these views are however opposed by the condition of *B. C.* in Weber's experiment, which, as is well known, almost invariably results in favor of the diseased or the more diseased ear in all of the more acute inflammations of the middle ear. This apparent contradiction still remains unsolved.

So much the more therefore do we need the full decisiveness of the results, as seen in the first two tables, in the chronic affections with a negative state of the parts, in order to maintain the value of Rinne's test for the latter.

Our experience may be summed up in the following short conclusions:

*The negative result of Rinne's experiment in all bilateral diseases of the ear, and in which there is not too great a difference between the hearing of the two ears, proves that some alteration is present in the conducting apparatus.*

This conclusion does not however read inversely, *i. e.*, we have no right to expect a negative result of the experiment in all cases in which the middle ear is affected. The experiment is on the contrary, much more frequently shortened, but positive, *viz.*:

1). *In the chronic conditions with negative mirror and catheter examination, and relatively good hearing (more than one meter for whisper).*

2). *In acute and subacute diseases of the middle ear, with exudation in the tympanum and despite great diminution of hearing.*

*In high degree of unilateral affections, inversely, the experiment may result negatively despite the fact that the sound-conducting apparatus is intact.*

*A normally long or but little abbreviated positive result of Rinne's experiment, with great diminution of hearing, and with otherwise negative mirror or air-douche symptoms, permits us to exclude any extensive disease of the sound-conducting apparatus, no matter whether the attack is unilateral or bilateral.*

The story told by the A fork is much more decisive in its testimony than that of the small fork, because the duration



of the negative experiment is longer, often — a, and on the contrary with a positive result it is likewise mostly elongated and frequently reaches + t. Lucae has repeatedly referred to *the remarkably good hearing for low tones by A.C.*<sup>1</sup>, and was often able in cases of decrease of the hearing from 150 to 10 Cm for whisper, to demonstrate that the fork c, which was only 1½ tone higher could be heard quite as long by A. C. as by persons with normal ears. He thinks that this at once excludes any essential disturbance in the sound-conducting apparatus, and assures the diagnosis of an affection of the labyrinth.

We owe to this more decided result of tests with the deep A fork, the short negative result of Rinne's experiment with A when a<sup>1</sup> is abbreviated and positive.

A positive result with A whilst a<sup>1</sup> is negative has never yet been observed, and such a possibility seems physically excluded.

The tables further confirm the fact, that the test for the perception of higher tones as recommended by Lucae, is a decided addition to our means of diagnosis, whilst Galton's whistle is admirable. With its assistance, in the same way as Burckhardt-Merian,<sup>2</sup> and Rohrer<sup>3</sup> have done, I have repeatedly discovered tone-gaps which justified us in locating the disease in the labyrinth, although of course we cannot exclude any complicating affection of the middle ear. Patients with truly labyrinthine disease more frequently exhibit a large and continuous defect belonging to the upper end of the scale.

Furthermore we frequently see a minute portion of the very highest part of the scale missing in patients whom all our other means of investigation would incline us to believe were suffering from an affection of the sound-conducting apparatus; this is especially seen in the more grievous forms of sclerotic processes, and my results in this direction coincide with those of Burckhardt and Rohrer.

<sup>1</sup> Die bei Schwerhoerigen zu beobachtende gute Perception der tieferen musikalischen Toene.—*Arch. f. O.* Band xv., page 273, and "Kritisches und Neues ueber Stimmgabelpruefung," *l. c.*

<sup>2</sup> Vergleichender Ergebnisse verschiedenartiger Hoerpruefungen.—*Archiv f. O.*, Band xxii., page 177.

<sup>3</sup> Der Rinnesche Versuch. Zuerich, 1885.

A case of ankylosis of the stapes, which I described in 1885,<sup>1</sup> may explain this abbreviation in the highest part of the scale with fixation of the conducting apparatus. The macerated bony specimen shows the stapes still in situ in the oval window, and on looking at its plate from the labyrinthine side, the inner surface is surrounded by a white smooth deposit upon the labyrinthine wall, which leaves but a small portion of the circumference around the plate free. The white deposit extends upward nearly to the border of the ampulla of the horizontal semicircular canal; *whilst downward it can be followed for some distance into the beginning of the scala vestibuli.* It has always been a source of unhappiness to me that the patient to whom this specimen belonged, though showing a negative Rinne of — 13 for a', with hearing of 6 cm for whispered voice, was never tested for the perception of high tones. The case is analogous to those in Table I, with otherwise negative condition under local examination, and the frequent abbreviation in the highest part of the scale as there exhibited, becomes comprehensible when we assume that in the more severe cases of this group the disease, like that in our post-mortem case, takes the shape of calcification of the periosteum of the labyrinth, and then extends into the beginning of the inferior convolution of the cochlea.

It is not the purpose of this paper to emphasize the importance which the accurate differential diagnosis between disease of the middle and inner ear as obtained by Rinne's experiment already holds out for us in a therapeutical point of view, and which may gain still further with time, inasmuch as the sound-conducting apparatus, at least by improvements in operative methods, promises to become more and more accessible to us.

On the contrary, I am still called at the end of this paper to point out the new vistas which comparative tests of the diseased ear open for our knowledge of the *normal function of the sound-conducting apparatus.*

The observations of Blake and Burckhardt-Merian, that perforations of the *Mt*, loss of the hammer and anvil, may

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<sup>1</sup> Erklärungsversuch, etc.

even increase the perception of high tones, prove similarly that a disease of the sound conducting apparatus in and by itself does not necessarily disturb this perception. And this, in connection with the diametrically opposite results discovered for deep tones in cases of impeded conduction of sound, leads to a physiological conclusion of the greatest importance.

Burckhardt-Merian tell us in the paper cited previously : "A certain group of aural patients of the most varying ages exhibit so excellent a bone-conduction, that even the firmest closure of both ears cannot weaken the perception for musical staffs and Galton's whistle." Again, he speaks of frequently witnessing normal hearing for these two kinds of instruments, whilst at the same time the patients are very deaf for conversation and low tones. In a case that he cites, the patient could not hear it thunder, but she could hear canary birds singing at a great distance. *Paracusis Willisiana* was also present.

I have seen the same thing in extremely deaf persons, with negative Rinne, whilst the tuning-fork could be heard longer by B.C. than in the normal ear. I have also seen patients of this sort who had never heard thunder. The very fact that despite this condition the perception for the high tones may be perfectly intact in such cases, permits us to conclude that the sound-conducting apparatus plays an inferior rôle or none at all in the transmission of this portion of the scale.

The lower portion of the scale behaves in quite a different manner toward the obstacles which disturb the unstable equilibrium of the conducting apparatus. Wollaston as far back as 1820 (*Philosophical Transactions*) observed that the deafness which is caused by too great a tension of the *Mt* is not uniform for the high and deep tones, but that under these circumstances there is only deafness for deep tones. "If he struck a table with the tip of his finger the board gave off a dull deep tone; if he hit it with his nail, a higher and more penetrating tone ensued. On rarefying the air in the tympanum, by forced inspiration whilst the mouth and nostrils were closed, he heard the latter tone (the higher) but not the deep tone. With rarefaction of

the air and increased tension of the *Mt* he could no longer hear the deep rolling sound of a wagon, but the rattling of chains and other iron work on the wagon could be easily perceived." Johannes Mueller, from whose "Handbuch der Physiologie"<sup>1</sup> I borrow the above quotation, was able to demonstrate the truth of this experiment upon himself, and explained it by the elevation of the fundamental tone for which the *Mt* is tuned.

The idea then suggested itself to me to repeat this simple experiment with the aid of tones that were pure, and whose pitch and intensity could be easily and accurately determined. I have for this purpose employed the several forks, including the two so many times mentioned, and have made the noteworthy discovery that we can *voluntarily and suddenly annihilate the tone of the large A fork whilst vibrating loud and close to the ear by rarefying the air in the middle-ear space*, as suggested above. If we next force the drumhead out by using Valsalva's experiment, the tone is heard once more in its former intensity. *We can produce this alternate disappearance and reappearance six or seven times, while the A fork is gradually dying away in front of the ear.* The tone is entirely lost until Valsalva's experiment is performed, or the tube is opened in some other way. The experiment is not wholly successful except with a fork free from overtones; *e. g.*, two of my forks a couple of octaves apart have overtones, the first one in the deeper fork being the fifth of the higher octave. Hence in forced inspiration the deep tone alone disappears, whilst the fifth is all the more distinct. The fundamental tone of the a fork, which is two octaves higher, must be moderately weak for it to disappear; when the a' fork is used, its tone is but slightly diminished by the experiment, whilst finally the experiment has no effect upon the intensity of the a'' fork.

Mueller also finds, that deafness may be produced by artificially forcing the *Mt* outward, as in Valsalva's experiment. This can be proved for high tones,<sup>2</sup> *e. g.*, the ticking of a

<sup>1</sup> Band ii., pag. 437.

<sup>2</sup> Valsalva's experiment makes me deaf to the ticking<sup>2</sup> of a watch, but this deafness ceases at once on resorting by forced inspiration, and the consequent rarefaction of the air in the tympanum; in point of fact the tension thus produced is apparently followed by an increase in the normal hearing for the watch.

watch, but not for those that are low. I am still doubtful whether the condensation of air in the middle ear, which pushes the *Mt* outward, produces tension in the entire sound-conducting apparatus or not, for it is not the tension produced on the *Mt* alone, but the terminal effect upon the ligamentum annulare, which is the decisive one. I have demonstrated anatomically,<sup>1</sup> upon the sound-conducting apparatus, that the maximal incursion of which the stapes is capable in the direction of the labyrinth, is (with opened tympanum) only one third as great as its maximum outward motion toward the tympanum, from which it seems that under normal conditions the tensor tympani with the rest of the forces which draw the apparatus inward, is just a little superior to the antagonistic action of the stapedius, labyrinthine pressure, etc., and that the action of a column of air forced against the membrane from within, is simply to resist this slight preponderance; the total effect will therefore be to relax the ligamentum annulare, whereby, as the above experiments show, we render it unsuitable for the conduction of higher, but not for that of lower tones.

The weight which is thrown upon the *Mt* by increased atmospheric pressure, such as we observe in pneumatic cabinets, acts in precisely the same manner as the artificial difference between the atmospheric pressure outside and inside the tympanum *Mt*, as caused by rarefaction of the air. Thus Mach and Kessel,<sup>2</sup> found diminution of the lower tones with a hydrostatic pressure of 14 *Cm*, and the latter author discovered, when testing with a low (four-feet open) organ pipe, that the fundamental tone disappeared, whilst overtones were perceived.

And more than this, various tests in persons who can voluntarily stretch the tensor tympani, are almost unanimous in showing that the low tones sound smothered during the contraction of the tensor of the drumhead.<sup>3</sup>

If we now compare with these physiological conditions

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<sup>1</sup> *Arch. f. O.*, Band xvi., p. 1.

<sup>2</sup> *Sitzungsber. d. k. Academie der Wiss.*, Band lxvi., Abth. 3, 1872.

<sup>3</sup> Lucae, *Physiolog. diagnost. Beitrage zur Ohrenh.*, *Berlin. klin. Wochenschr.*, 1886, 32.



the facts which we have obtained from the previous collection of pathological alterations in the sound-conducting apparatus, Table I has shown that amongst 58 ears in which we were justified in assuming the presence of sclerotic processes in the connecting chain of ossicles, the T.F. A, free from overtones, was not heard in 32 cases by A. C. and once (with a hearing of 3 *Cm* for conversation) this was also the case with the a' fork.

A similar state of things was discovered in destructive diseases of the sound-conducting apparatus as shown in Table III; here too the aërial conduction in 30 ears (with but partial and moderate diminution of hearing for conversation) was 17 times 0 for the large A fork, and once for the a' fork (with a hearing distance of 2 *Cm* for conversation). The negative result of Rinne's experiment in the remaining cases permits us to assume that the A. C. for deep forks has been considerably abbreviated.

It may here be remarked that Hartmann,<sup>1</sup> in concordance with the above results, "in old cases of suppurative inflammation of the middle ear, destruction of the *Mt*, and sclerosis of the tympanic mucous membrane, and in processes which v. Troeltsch entitles "dry catarrh" or other "sclerosis of the tympanic mucous membrane," found that the c fork which he employed as a test, and which is but a small third higher than my A fork, could not be heard by A. C.

This opposite condition of high and low tones in partial or total interference with the function of the conducting apparatus compels us to acknowledge that :

*The sound-conducting apparatus serves to transmit only those waves of sound for the lower portion of the scale which strike the ear by aërial conduction ; for the upper part of the scale it is superfluous.* Whenever the function of the conducting apparatus is disturbed, the ear loses its capacity for the perception of aërial tones of the lower part of the scale, at least from A, downward, which strike it by aërial conduction.

This view, however, which arises from the above investigations, leads to a second conclusion of universal importance for the entire animal world, and at which I can only hint.

<sup>1</sup> Typen der verschiedenen Formen von Schwerhoerigkeit.



The accessory apparatus, which in the form of the sound-conducting chain only gradually is added in mammals to the percipient apparatus of the ear, indicates an extension of perception for the scale of tones by some octaves lower. This, however, does not hinder the possibility of a different arrangement of the ear in other organizations for the reception of low tones. Those animals that live under water are excluded from comparison, because waves of sound are conducted to their ears by another medium.

THE GRAPHIC REPRESENTATION OF THE  
RESULTS OBTAINED BY TESTING THE  
HEARING WITH TUNING-FORKS.

BY ARTHUR HARTMANN, OF BERLIN.

(With four wood-cuts.)

Translated by J. H. SHORTER, M.D., New York.

JACOBSON, in a publication in regard to the dependence of the acuteness or the duration of hearing, gives his opinion on the method which I employ in testing the hearing with tuning-forks, *Arch. f. Ohrenkeil.*, vol. xxiv., S. 39.

As this subject is one of the most important in otology, because every method which tends to the perfection of our diagnosis enables us to give greater accuracy in our therapeutic actions, I considered it advisable to discuss the matter from an entirely objective point of view.

Jacobson in his paper compares my method with the one employed at the Berlin Otiatric University Polyclinic. The method employed at that institute, according to his description, is as follows: The tuning-fork is made to vibrate by striking it in any way that one chooses, without employing any particular force, and then held in front of the patient's ear at a distance of about a centimetre ( $\frac{2}{3}$  of an inch) away from the external meatus. The patient is then asked to mention by word the moment he ceases to hear the sound. Immediately after, with the least possible loss of time, the fork is brought up close to the ear of the observer, and an estimate made of how great the acuteness of the

patient's hearing has been diminished for that particular tone by the relative intensity of the tone still audible to the observer—the same method which has been already described by Dennert in No. 18 of the *Ber. klin. Wochensch.* for 1881. Jacobson further remarks that formerly when the difference in hearing between the pathologic ear of the patient and the normal one of the observer was noted down in seconds, the numbers that were obtained were not meant to be employed as an exact criterion of the patient's acuteness of hearing, and that he had already formerly considered such a procedure as not permissible.

If then, for example, we make the tests with a tuning-fork, whose time of vibration in air is about 60 seconds, and the first patient hears the sound during 30, the second during 35, the third during 40 seconds, we obtain in this way an exact criterion of the degree of deafness in these cases; we know exactly that the second patient hears better than the first, the third better than the second, since the amplitude of the vibrations representing the intensity of the tone exactly decreases with the duration.

That the decrease cannot be considered completely symmetrical for the spaces of time concerned, from a scientific point of view, is, with reference to the laws of vibration in tuning-forks, obvious. Nevertheless, that the first ear is deafer than the second, the second deafer than the third, has been exactly determined. Jacobson proceeds in the following manner: When the first patient ceases to hear the fork he brings it up to his own ear and estimates the intensity of the sound (which the tuning-fork is still emitting). He proceeds in the same manner with the second and third patient. And now Jacobson believes that in these experiments he can appreciate every time the intensity of tone which he hears. Estimation as to the loudness or faintness of a sound is entirely dependent on the judgment of the observer. So this method has therefore no claim to validity.

The first fault which Jacobson finds in my method for testing the hearing is, that I endeavor, in opposition to the method pursued at the Berlin otiatric clinic, to determine

the absolute duration of the perception of sound, instead of determining merely the difference in duration of the perception of sound between the pathological and the normal ear. Jacobson points out very properly that the method of noting the absolute duration of the perception of sounds in determining the acuteness of hearing, is only accurate, provided the tuning-fork is struck every time with exactly the same force.

Jacobson adds that it might be assumed that Hartmann would use for his experiments tuning-forks which have some particular mechanical arrangement similar, for instance, to those which Prof. Lucae and, later on, Eitelberg have described. But as such forks have been already recommended long before by Blake, without it having been possible to introduce them into common use, Jacobson might have well drawn the conclusion that any such arrangement was worthless. I had myself for a number of years worked in the same direction—to make, according to Blake's proposal, the testing with tuning-forks a more exact method, but had soon been convinced that all theoretical considerations were useless, and that the ordinary tuning-forks perfectly satisfy the demands that we make on them in our examinations. Jacobson will arrive at the same result if, instead of theorizing, he will begin to experiment. He will come to the conclusion that the "simplex veri sigillum" holds good also in our case.

That it is possible to fix upon an average vibrating duration by simply striking the forks, Jacobson could already have inferred from the assertion of his chief, whose opinion on this question, published, for example, in *Arch. für Ohrenheilkunde*, vol. xxiii., p. 129, is as follows: "The vibrating duration of the fork (a small c fork, furnished with weights) amounts on the average to 35 seconds for air-conduction to ten seconds for conduction through the mastoid process; while for another fork of almost similar dimensions, these numbers increase up to 75 and 30 respectively."

In the same manner "Emerson,"<sup>1</sup> in his extensive exper-

<sup>1</sup> "The Testing of Hearing with Tuning-Forks," *Zeitschrift f. Ohrenheilk.*, American edition, vol. xiii., S. 53.

iments, succeeded in obtaining for practical purposes a sufficiently equal duration for any tuning-fork, by simply striking the fork on his knee.

In order to show how very little difference there is in the results obtained, by employing the method of striking the fork on a block of wood, I will give as an example two investigations made on patients—the one conducted by myself, the other by one of my assistants, Dr. Killian, regarding which I wish to lay particular stress on the fact that these patients were not particularly selected cases.

In the following tables, under the designations  $c$ ,  $c^1$ ,  $c^2$ ,  $c^3$ ,  $c^4$ , the vibrating duration is recorded for the examination by air-, as well as that for bone-conduction, and for three successive examinations, from which afterwards an average was obtained.

I.

	$c$	$c^1$	$c^2$	$c^3$	$c^4$
L	22	20	18	21	22
	23	25	17	21	18
	23	23	17	17	21
R	22	17	10	12	13
	25	13	9	15	13
	20	17	10	11	12

II.

	$c$	$c^1$	$c^2$	$c^3$	$c^4$
L	15	18	15	33	13
	15	17	17	35	14
	15	17	17	35	17
R	13	5	4	13	7
	12	7	4	11	7
	12	8	5	11	7

From such experiments, made by others as well as myself, it is evident that for all practical purposes an altogether sufficient symmetry of stroke can be obtained.

Jacobson considers as a second and even greater error than the one already mentioned, the fact that I endeavor to determine the acuteness of the patient's hearing from the results obtained by comparing the duration of the perception of sound in the good and bad ear—a proceeding to be considered as entirely invalid from a scientific point of view.

My method for testing the hearing I have described in the

following manner<sup>1</sup>: "In order to obtain, by aid of various tuning-forks, a complete picture of a certain form of deafness, I have employed the vibratory duration for the patient's ear as part of a fraction (numerator) whose denominator represents the duration for the normal ear. In my record I had made this normal duration equal to 100. If, for example, a tuning-fork that is heard by the normal ear for 40 seconds remains audible to the deaf ear for 10 seconds, then the fraction would be  $\frac{10}{40} = \frac{25}{100}$ . The formula would be as follows—40 : 10 :: 100 :  $x$ , that is  $x = 25$ . That is, in the scale which has been divided into 100 parts, 25 parts are marked off. This same method is continued with forks of different pitch; the results obtained are recorded in the same way.

Formerly I used six tuning-forks, now I only employ five in my investigations, as I find that number to be sufficient:  $c = 128$ ,  $c^1 = 256$ ,  $c^2 = 512$ ,  $c^3 = 1,024$ ,  $c^4 = 2,048$  vibrations. The low-pitched are brought to vibrate by squeezing with the fingers and suddenly letting go, the high-pitched by striking them sharply and forcibly on a block of wood. When examining a patient by air-conduction, I place the fork before the ear in such a way that the ends of the tines are held as near to the opening of the external auditory canal as possible.

When examining the bone-conduction, the fork is set perpendicularly upon the mastoid process. The best-adapted forks are those which have a vibratory duration of about 30–60 seconds for the normal ear. The average for each fork must be tested by repeated examinations on several persons possessed with normal hearing. In examining patients I find the average obtained from these consecutive tests, and these results are afterwards recorded in the scale, which has been divided into 100 equal parts.

The charts employed in recording the results of the

<sup>1</sup> The graphic representation of the results that are obtained in testing the hearing with tuning-forks. *Deutsche Mediz. Wochenschrift*, No. 15, 1885. On the diseases of the Ear and their Treatment; 3d edition, 1885.

Types of the various forms of deafness represented graphically according to results obtained with tuning-forks of different pitch. Besides a chart for testing of the hearing.

Berlin: Fischer's Med. Buchhandlung, 1886.



examinations of cases of impaired hearing are so arranged that the upper half is used for registering the results obtained in the examination for air-conduction; the lower half for the results obtained in the examination for bone-conduction. The proportion, calculated in percentages, of the time that the tuning-fork is heard by the deaf ear, to the time determined as the average for the normal ear, is then registered in red colors in the spaces allotted for the several tuning-forks. The results obtained for bone-conduction I have not registered in their proportion to the normal standard found for bone-conduction, but have recorded these also in their relation to the average normal hearing by air conduction, as we are thus enabled to make better and more direct comparisons between the air- and bone-conduction. It must be remarked, however, that the vibratory duration is much shorter when the tuning-fork is rested on a solid body than when allowed free vibration in the air (Bezold).

The schemes obtained in this way were placed in seven different categories, and the different types of deafness were determined through the results obtained. Types I and II represent severer forms of deafness for low-pitched tones, and with varying bone-conduction, good or bad. Types III and IV severer deafness for high-pitched tones, with both good and bad hearing by bone-conduction. Types V and VI represent an equal deafness for both low- and high-pitched tones. Type VII irregular forms of deafness.

Subjoined I now give four types illustrating the results of the examination of deaf persons with different pathological changes. I have already published them in the third edition of my work, "Diseases of the Ear and their Treatment."<sup>1</sup> I still made my tests at that time with six forks, A, c<sup>1</sup>, c<sup>2</sup>, g<sup>2</sup>, c<sup>4</sup>, g<sup>4</sup>, the duration of hearing for the normal ear by air-conduction being respectively 20, 63, 45, etc. This is recorded in the middle of the chart. The vibratory duration for the pathological ear in question is recorded in figures representing the proportionate value. The spaces representing the degree of hearing for the left ear are

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<sup>1</sup> Translated into English by Jas. Erskine, G. P. Putnam's Sons, 27 and 29 W. 23d Street, New York.

Type I.

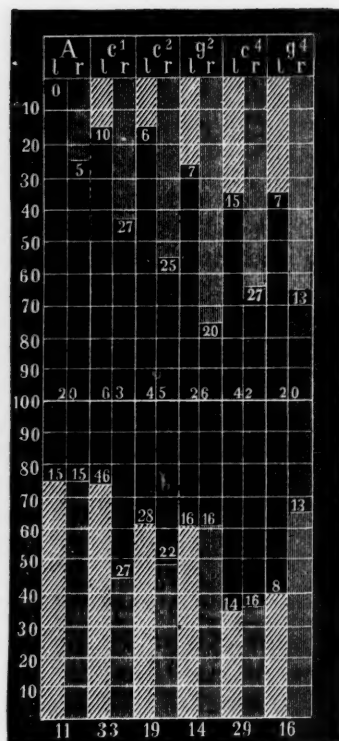


FIG. 1.

Type IV.

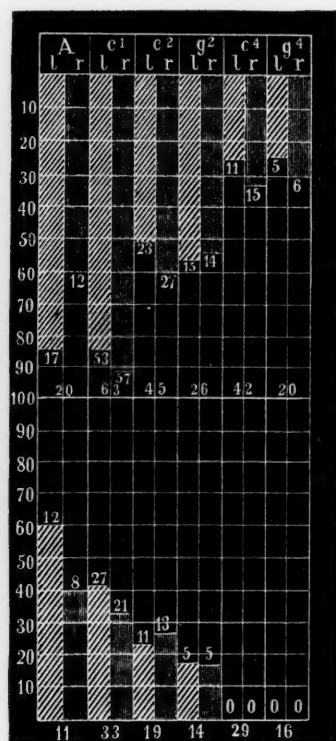


FIG. 2.

recorded in the upper half of the chart, and shaded obliquely, that for the right ear in upper half and shaded perpendicularly. At the lower end of the chart are recorded the vibratory durations for the normal ear by bone-conduction, *e. g.*, 11, 33, 19, etc. The vibratory duration for the pathological ear by bone-conduction is recorded similarly as above, and also in numbers representing their proportion to the normal hearing by air-conduction. The diagrams thus obtained are so clear and characteristic that one can immediately tell what form of deafness we are dealing with without the necessity of any further explanations.

Types I and II, representing severer deafness for low-pitched tones, were found, on the one hand, in old purulent inflammation of the middle ear, which had run its course, with destruction of the drumhead and sclerosis of the mucous membrane of the middle ear; on the other hand, in

Type V.

Type VII.

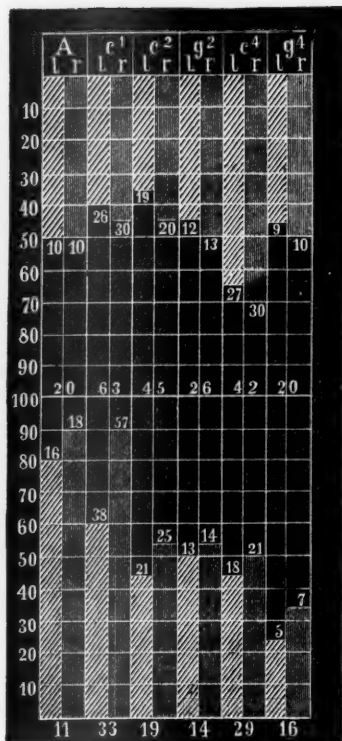


FIG. 3.

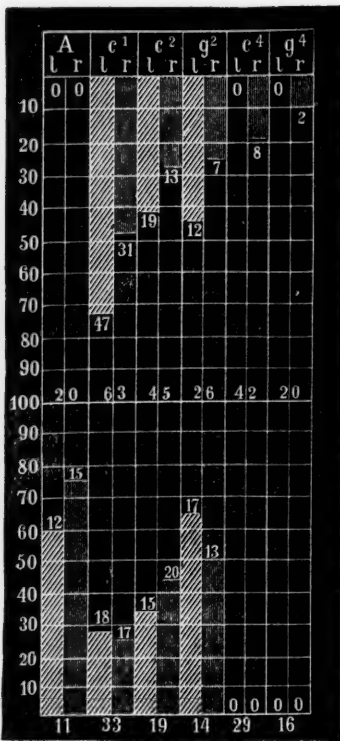


FIG. 4.

cases of so-called dry catarrh (v. Tröltsch) or as sclerosis of the middle ear—cases in which the otoscopic examination revealed opacities and retractions, in some cases even a normal condition of the drum-membrane.

Types III and IV, representing severer deafness for high-pitched tones, were found in most cases with otoscopic examination generally showing a normal drumhead. These were cases in which, from the clinical features, along with the results obtained by this method of investigation, we could only diagnose a pathological condition of the nervous apparatus. Besides this, in a few cases of both types were found opacities and retraction of the drumhead, and in a few others acute inflammation of the middle ear was found.

To Types V and VI, representing an equal degree of deafness for different tones, belong the greatest number of cases which I examined. These types are found chiefly in

cases of middle-ear inflammation, combined with perforations and secretions; also in cases with drumhead still intact; some of them normal; some in part opaque and retracted. Furthermore, to this category belong a few cases of thrombus sabaceus, and of deafness after meningitis.

Type VII.—Irregular forms of deafness were found comparatively seldom, and in diseased conditions the most diverse, as well in cases of old suppurative inflammation of middle ear which had run their course, and of sclerosis, as also in cases in which the relations seem entirely normal, so far as could be determined by direct examination.

Jacobson makes the following objection to my method of expressing the intensity of sound through the proportion already stated, namely, that the intensity of sound diminishes not arithmetically but geometrically with the increase of the distance.

To this objection one can reply as follows: That in the same proportion as the intensity of sound is diminished when employing the tuning-fork, it also diminishes with the ordinary acoumeters, the watch, the Politzer acoumeter, or the voice, as we may employ them at different distances in testing the hearing. The intensity of the sound is always inversely proportionate to the square of the distance. Although this law should control all our judgments as to the results that we obtain by our methods of testing the hearing, it has been very little regarded by writers on otological subjects. It is not even mentioned in the hand-books of Tröltsch, Politzer, or Schwartze. I have also prudently kept silent. Only in the hand-book of Urbantschitsch did I find it mentioned, and then very modestly, in fine print.

Yet the proposition of Prout and Knapp, to record the result obtained in testing the hearing as a fraction of the normal hearing distance, has been generally adopted, although this system, were we to regard the objection that Jacobson has been making, could not be used under any circumstances, as the method is scientifically incorrect. It seems that here, therefore, the practical sense of the otologists has guided them aright.

Vierordt comes also to the conclusion from a purely physiological and acoustic point of view that, "for such

very weak sounds it would be more correct to assume that they decrease in direct proportion to the distance."

The tests which I have undertaken in great number, and which can be easily repeated by others, show that they always afford comparatively characteristic results, which completely suffice for practical demands; that with it the sources of error are so restricted that they can remain unnoticed.

In the above I have been obliged to discuss theoretical topics which are still open to controversy, but I believe to have proved that my method of representing graphically the results obtained (in testing the hearing) satisfies most completely both practical as well as theoretical claims. I wish though to point out particularly that my method of representation ought not to draw forth such disputes; for it is based on the "principles of Conta" for testing with tuning-forks. The subject in question is merely as to a method of recording results obtained by pursuing a certain system of investigation. How such a record is constructed, whether the figures are merely noted down as they are found, one after the other, or in proportion to certain other quantities, makes no difference whatsoever; it is only necessary that the table represent clearly certain facts which have been found.

In criticising our methods of testing the hearing, we come to the conclusion, unfortunately, that they are all imperfect, no matter whether we use the human voice, a watch, or any other acoumeter. Science possesses as yet no instrument to measure the intensity of sound accurately, if we disregard the phonometer devised by Schafhäütl or Vierordt, which cannot be of much use for practical purposes. If we wish, which for our purposes is absolutely necessary, to test the tone-perception, we, up to this time, do not possess a more useful instrument than the tuning-fork. As soon as other more perfect instruments are devised, and which can be used just as simply, we shall be very glad to give up our tuning-fork. Until then the tuning-fork remains our most important and best working instrument. A broad judgment on the results obtained by the use of several tuning-forks can, however, only be acquired by recording the results connectedly and consecutively, in the manner that I have published.

## POLYPUS OF THE TYMPANIC CAVITY WITH IMPERFORATE MEMBRANA TYMPANI.

By A. EITELBERG.

AURIST TO THE GENERAL POLICLINIC IN VIENNA.

Translated by Dr. MAX TOEPLITZ, of NEW YORK.

**P**OLYPI of the tympanic cavity with imperforate membrana tympani are a great rarity, at least as regards the number of the existing publications of such cases. To my knowledge such a communication is made by Gottstein only.<sup>1</sup>

The case which I offer for publication is as follows:

December 3, 1885, Marie Br., fifteen years old, presented herself in my office with the statement that she was suffering for three days from continuous intense pain in the right ear. The history revealed that three years previously the patient had had a stinging sensation in the same ear for about a week, and had been troubled with tinnitus for two weeks previous to the beginning of the pain.

The examination showed the posterior part of the *Mt* to be bulged out, swollen *in toto*, partially devoid of epidermis and of reddish-gray color. Handle of malleus not discernible. In the external meatus lamellæ of epidermis were found in masses, which, of course, were removed thoroughly before the inspection of the *Mt*. With Politzer's method no perforation noise could be heard, no retrogression of the bulging following it, but the pain was greatly relieved and soon stopped entirely.

I examined the *Mt* with the probe to convince myself whether fluctuation could be detected in a *Mt*, bulged outward by a dis-

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<sup>1</sup> *Arch. f. Ohrenheilk.*, vol. iv., p. 85.



charge in the tympanic cavity. I did not, however, feel any fluctuation, but a doughy resistance. This surprised me, but I ascribed it to the swelling of the membrana tympani.

As the bulging of the *Mt* persisted, I did not abstain, in spite of the absence of pain, from performing paracentesis. But in place of the supposed pus a roundish, red tumor appeared in the opening. The secretion from the mucous membrane of the tympanic cavity in the first few days was slight, but later became profuse; the perforation became markedly enlarged in the meantime. It was not until then that I could determine the seat of the polypous growth. The growth was the size of a pea, and sprang with a broad pedicle from the mucous membrane of the promontory.

Instillations of absolute alcohol, experimentally tried, produced so violent a burning sensation that the timid patient got an aversion for this remedy. Lukewarm baths with a 4 per cent. solution of boric acid, containing 10 grms of spirit. vin. rectificat. in 15 grms of aq. destill., were prescribed. I could not propose an operative removal of the growth at this time, as I was afraid that the patient would escape further observation. Besides syringing and cleansing the ear, Politzer's method also was employed in the usual manner.

In this way I treated the patient successfully. After about two weeks the discharge began to diminish and the polypus to shrink. After four more weeks it had entirely disappeared; the opening became gradually smaller and finally closed. The membrana tympani was thickened and of a whitish-gray color, the place of the paracentesis was marked by a dull shining line. The handle of the malleus remained indistinctly visible.

The hearing had improved on the right side from 0 to 10 cm for my watch; medium loud conversation was heard as far as the full length of the room (six metres), when the left ear was closed. The patient was satisfied with this result, and stopped treatment.

ON THE QUESTION OF TESTING THE HEARING  
BY MEANS OF TUNING-FORKS.

By A. BARTH, OF BERLIN.

(With two wood-cuts.)

Translated by Dr. MAX TOEPLITZ, New York.

AT the fifty-ninth meeting of German naturalists and physicians, after a paper by Hartmann, and on the following day after a demonstration by Lichtenberg, Jacobson, deemed it necessary, from a physical standpoint, to protest against the assumption that the power of hearing could be measured by the duration of the perception of sound from tuning-forks. I was astonished that none of the authorities who have rendered extremely valuable services in the employment of tuning-forks made any remarks either for or against this assertion, save the few words spoken *en passant* by Rohrer. When, therefore, Jacobson repeated his objection, I felt obliged to answer: "That in examinations by tuning-forks, bells, etc., repeated upon the same healthy or diseased person, concordant results are always obtained. That, in the duration of vibration, we have an available measure, is undoubted. Whether the vibrations decrease in arithmetical or geometrical progression, is immaterial."

Jacobson made opposition to this remark. My defence is as follows: First, we cannot, of course, make our examination with mathematical exactness. In this Hartmann, Jacobson, and myself agree. The main sources of error consist in the irregularity of striking the tuning-fork, and in the uncertainty to determine the moment when the sound has died away. These errors, however,

can be avoided by somewhat experienced examiners. Another error might occur through the (possibly varying) logarithmical decrement. I will even add another peculiar occurrence, namely, that according to recent investigations<sup>1</sup> the physical facts do not harmonize with physiological conditions. As, however, hardly any method of examination gives absolutely exact results, these errors are not considerable; it is sufficient that the tuning-forks vibrate equally and during the same time. In the following discussion, therefore, I presuppose, for the sake of simplicity, equal vibration, equal decrement, and a certain relation of the physiological intensity of the tone to the physical condition.

Let us now first consider, one of the more important facts of which Hartmann is said to have taken a wrong view, namely: "That the decrement of the amplitude of vibration takes place in a tuning-fork in the same manner as in every other vibrating elastic body, theoretically not in arithmetical but in geometrical progression." Every kind of vibration decreasing in any progression I can imagine as an isosceles triangle, in which the initial amplitude is indicated by the base, the duration of vibration by the altitude. I have here drawn, according to custom, and on account of simplicity, only one half of the triangle, in which  $bc$  and  $\beta\gamma$  indicate the duration of vibration,  $ab$  and  $\alpha\beta$  half the amplitude. I will now suppose, for all my following deductions, that the sounding of the tuning-fork is equally strong, namely,  $ab = \alpha\beta$ . I can understand how Jacobson imagined the subject, when comparing the arithmetical and geometrical series of figures. He apparently thinks that Hartmann is measuring the "absolute duration of perception." If Fig. 1 represents the decrement of vibration in arithmetical, Fig. 2, on the contrary, in geometrical progression, it is evident that if the patient perceives, *e.g.*, the tuning-fork during one third of the normal time of hearing, in this case  $be$  is not equal to  $\beta e$ .

But this has not been asserted by anyone. Hartmann places the pathological duration of perception in a relation

<sup>1</sup> Vierordt: *Die Schall- und Tonstärke und das Schalleitungsvermögen*. Tübingen, 1885. This number.

to the normal one, and says  $be : bc = \beta\epsilon : \beta\gamma$ , and if we proceed further, then we have also  $ab : de = bc : ec = \beta\gamma : \epsilon\gamma = \alpha\beta : \delta\epsilon$ . But as  $ab$  is  $= \alpha\beta$ , we must have  $de = \delta\epsilon$ . This means: whether a tuning-fork sounds out quickly or slowly, the amplitude will always be equal in the same fractions of the duration of vibration, if the initial amplitude remains the same. This is my conception of the subject. Dr. Koenig, assistant at the physical institute of this city, with whom I have occasionally discussed this question, has kindly promised a purely mathematical argument of the subject, which will appear in one of the following numbers of these ARCHIVES.

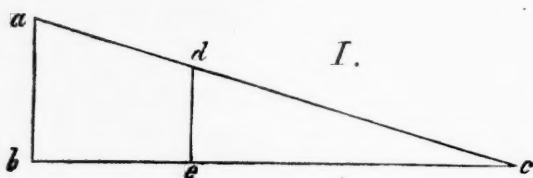


FIG. 1.

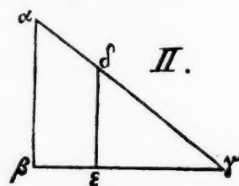


FIG. 2.

The same diagrams as the above, and the same equations, may be referred to Jacobson's remarks on the intensity of tone. For, if the amplitude decreased in any progression, and if the intensity is in a certain, known relation to the amplitude, the intensity also must decrease in the same relation. Here also, then, we have the result: With equal initial intensity it is quite indifferent whether the intensity decreases rapidly or slowly; with equal fractions of the duration of vibration the intensity will always be the same.

If Jacobson wishes further to make us believe that somebody has compared the hearing-duration of high and low-pitched tuning-forks in the same manner as he has warned against on page 41 of vol. xxiv. of the *Archiv f. Ohrenheilk.*, he is again incorrect. The examination is made with the many varieties of low and high tones as to their perception by normal and diseased ears. If we then place normal and pathological duration of perception in relation to each other, no theoretical objection can be made to comparing the results of different tones with each other.

We therefore leave the judgment of Jacobson's criticism to each individual reader. For my part I will only add, that I consider the examination with the tuning-fork the most exact of all examinations of hearing which are now practised.<sup>1</sup> It is true that it is capable of being much improved, and I consider Hartmann's suggestion a step in the right direction. Its greatest fault is that it requires much time when carefully executed. It will therefore always remain limited to certain cases only.

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<sup>1</sup> Helmholtz : *Die Lehre von den Tonempfindungen*, 1877, p. 14, last line a.f.

## A CASE OF NECROSIS OF THE COCHLEA.

By A. HARTMANN, OF BERLIN.<sup>1</sup>

Translated by Dr. MAX TOEPLITZ, of New York.

THE literature of the numerous cases of necrosis of the labyrinth communicated up to date has already been compiled by Bezold in his excellent paper (*cf.* next number of these ARCHIVES), and utilized for general conclusions. Among the cases observed are very few in which the examination for hearing showed traces of remaining hearing faculty, as in the case which I now briefly relate:

Mr. T. R., student of the technical academy, after a cold, as he supposed, caught November, 1884, acquired an acute inflammation of the left ear, followed by a purulent discharge. April, 1885, a polypus was removed with the loop, followed by intense pain and paralysis of the facial nerve; removal of polypi under chloroform with the sharp spoon is said to have also been attempted. At the end of April the mastoid process was opened with the chisel; a communication of the opening with the external auditory meatus is said to have existed. Patient then changed his physician, and at the beginning of June a sequestrum of the size of a pea was removed from the meatus, whereupon the facial paralysis slowly disappeared. In the external meatus stenosis and granulations developed. In order to facilitate the escape of the offensive secretion repeated efforts were made to enlarge the canal, the knife and galvano-cautery being employed for the purpose. At the beginning of October, headache, vomiting and fever occurred, together with disorders of the general health. These

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<sup>1</sup> According to a communication made to the otological section of the 59th meeting of naturalists in Berlin.



symptoms disappeared after a few days. Repeated asthmatic attacks also set in.

March 25, 1886, patient came under my care; he was still very much weakened from his sufferings, which had existed a year and a half; his complexion was pale, his general health being otherwise good. There was no paralysis of the facial nerve; moderate discharge of puriform fluid, not offensive. The external meatus was extremely narrowed at the bottom, small granulations being found behind the stenosed portion. The probe detected rough bone which was slightly movable. The following day this bone could be removed with the small sharp hook. The sequestrum proved to consist of a portion of the cochlea, including about the two upper turns.

The examination of the hearing with tuning-forks showed that the patient heard the tones of seven octaves,  $c-c^5$ , from the vertex on the healthy right side. From the left mastoid process nearly all of the tuning-forks were heard. On the right side it could not be determined whether the small  $c$  fork was heard on the right or left side; the  $c^1$  and  $c^2$  forks were both heard markedly stronger on the left than on the right side. Gruber's experiment, which consists in placing the tuning-fork upon the finger closing the external meatus, showed the same result, only the small  $c$ ,  $c^1$ , and  $c^2$  forks were perceived. Hence, it follows that the perception of the tones of the low tuning-forks of  $c$ ,  $c^1$ , and  $c^2$  was transferred from the mastoid process in the first, as in Gruber's experiment, to the side devoid of the cochlea. On the other hand, the high tuning-forks were heard by the patient on the healthy side. The examination of the hearing with other auxiliaries, the watch, Politzer's acoumeter, and whisper, gave a negative result. The latter was repeated, at 25 cm, after closing the external meatus, without change of distance. To my regret I could examine the patient but once, as he was compelled to leave very soon after removal of the sequestrum. According to a subsequent communication, the discharge continued for several months under the use of iodoform, but then ceased completely under the use of boracic acid.

Among the 46 cases of necrosis of the labyrinth compiled by Bezold, there are 5, in which the examination of hearing had shown traces of remaining hearing faculty (17 Guye, 20 Cassels, 35 Christinnek, 38 Jacobson, 39 Gruber). Schwartz's case might be classed among these as:

6th. (Case 31 of Bezold's compilation) "watch is not heard, but tuning-fork from the skull by the diseased ear."

7th. In a case referred to by Lucae (*Arch. f. Ohrenheilk.*, vol. x., p. 236), in which the upper two thirds of the necrotic cochlea were removed, the large forks  $c'$ ,  $c$ , and contra  $A$  were perceived from the occiput equally in both ears.

Kaufmann reports in a paper (On partial hearing power after necrosis of the labyrinth<sup>1</sup>) the following case from Zaufal's clinic:

8th. The exfoliated sequestrum embraced fully two thirds of the left cochlea. The watch was heard on this side in contact with the temple. From the tuberosity of the occiput the  $c$  fork was heard better on the left than on the right side. An entire scale of tuning-forks is perceived in the left ear, when placed upon the finger which occludes it.<sup>2</sup>

9th: Burckhardt-Merian,<sup>3</sup> in a patient whose necrotic cochlea was removed, could show that the tuning-fork, placed upon the vertex, was heard in the healthy ear; when the tuning-fork was displaced to the affected side the tone appeared to be on that side. When the external meatus was closed on the healthy side the tone was heard on the healthy side; when the external meatus was opened again, on the side without cochlea.

10th. The most striking case is that of Stepanow,<sup>4</sup> concerning a patient in whom about  $1\frac{1}{2}$  turns of the necrotic cochlea were removed. "The patient was examined with all tones within the limits of perception, from the lowest to the

<sup>1</sup> *Prag. med. Wochenschr.*, 1885, No. 49.

<sup>2</sup> In Czarda's case, mentioned briefly by Kaufmann, only a portion of the upper semicircular canal with the oval window was removed, so that this case may be left out of consideration. In both cases of Dennert, related by Kaufmann in his list, complete deafness existed in the affected ears, as Dennert states himself.

<sup>3</sup> Troisième Congrès internat. d'Otologie. *Compt. rend.*, p. 796.

<sup>4</sup> *Monatsschr. f. Ohrenh.*, 1886, No. 4.

highest ones; there were no tone-gaps." At the examination with the watch from the median line of the skull the watch was heard in the open ear, either the affected or the healthy one, when one ear was closed. This was also found for acoumeter and tuning-fork tones. Such a result is considered a diagnostical expedient for detecting simulation.

If we consider the different deductions of Stepanow from this point of view, we obtain a number of points of support, which make the suspicion of simulation appear not to be without foundation.<sup>1</sup>

As to the explanation for the striking result of the examination in these particular cases, I refer to Bezold's account, with which I agree in every respect. Our patients with extreme hardness of hearing or deafness on one side are not able to localize with precision. According to Kaufmann's observation, Gruber's method appears to be apt to produce such delusions as to render it hardly appropriate as a safe diagnostical expedient.

If in addition to the uncertain localization of sound we consider that by the bone-conduction, as is well known, speech, and also the tones of the tuning-fork, may be transported to the healthy ear, and if the cases in which the examination was not verified in the most careful manner, according to Dennert's method, have no convincing value, then the cases of necrosis of the labyrinth, reported in literature, in which a small amount of hearing is said to have been left, are hardly to be considered as trustworthy. Gruber<sup>2</sup> was able to prove in the most positive manner the existence of complete deafness in necrosis of the cochlea in a case in which both cochleæ were almost entirely destroyed. The examination of hearing made with the most varied expedients resulted in the fact that complete deafness existed on both sides. Until further observations free from any objection are communicated, we must cling to the view that absolute deafness is connected with necrosis of the cochlea.

<sup>1</sup> As regards the criticism of Stepanow's case, and his explanation, or his inconclusive argumentation, I refer to the paper in question by Steinbrügge and myself, in vol. xvi., p. 245, Germ. edition of these ARCH. Moos. (Will be translated.—K.)

<sup>2</sup> *Wiener. allg. med. Zeitung.*, 1864.

# REPORT ON THE PROGRESS OF OTOLOGY DURING THE LATTER HALF OF THE YEAR 1886.

## I.—ANATOMY AND PHYSIOLOGY.

### ANATOMY.

Dr. E. C. SPITZKA, New York. Intra-axial course of the auditory tract. *New York Med. Jour.*, Sept. 18, 1886.

In the dolphin the relatively very large (hypertrophic) auditory tract has enabled the author to trace quite definitely the course of the tract from the cochlea to the auditory centre in the cortex. His observations confirm, in the main, the atrophy observations of BAGINSKY. Going from without inward, we have : 1, cochlea—2, posterior division of the 8th pair—3, trapezium of the same side ; crosses—4, part of lemniscus—5, posterior pair of corpora quadrigemina—6, internal geniculate body—7, corona radiata—8, cortex of auditory field.

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### PHYSIOLOGY.

Dr. W. S. LENTE. In the physiology of hearing is there an overlapping of each auditory field, the same as in the binocular field of vision ? *Trans. Amer. Otol. Soc.*, 1886.

The author finds that there is an overlapping of the fields of audition of  $10^{\circ}$  to either side of the median line : that is, there are  $20^{\circ}$  in the median line common to both fields. The author thinks that such a condition of the auditory fields assists us in estimating the direction from which sounds proceed.

S. M. B.

## II.—PATHOLOGY AND THERAPEUTICS.

By A. HARTMANN, of Berlin, and ED. SCHULTE, of Milan.

Translated by Dr. MAX TOEPLITZ, of New York.

### GENERAL LITERATURE.

1. Prof. BÜRKNER. Report on the cases observed at the policlinic of aural diseases, in Göttingen, in 1885. *Arch. f. Ohrenheilk.*, vol. xxiii., p. 269.

2. Dr. BRUNETTI. Cenni statistico-clinici sul primo anno di pratica otorica in Venezia. *Rivista Veneta di scienze mediche*, 1886.

3. Prof. V. COZZOLINO, of Naples. Lezione sulle malattie dell' orecchio. *Napoli*, 1887.

4. Dr. SCHMIEGELOW, of Copenhagen. Bidrag til Bedømmelsen af Öresygdommen. Hjøppighed blandt Skollböm, in Denmark *Hosp. Tidende*, vol. iv., p. 1057.

5. Dr. V. GRAZZI, Florence. Tosse ed altri fenomeni morbosi d'azione riflessa auricolare. *Bolletino per le malattie dell' orecchio*, etc., No. 6, 1886.

6. C. J. BLAKE and T. M. ROTCH. Reflex aural symptoms without aural disease. Aural disease exciting reflex symptoms. *Amer. Jour. Med. Sci.*, October, 1886.

7. Dr. A. EITELBERG, Vienna. Otological communications. *Wien. med. Presse*, 1886.

8. Dr. A. S. WYSS. Étude clinique des complications auriculaires d'ozène. *Inaug. Dissertat.*, Geneva, 1886.

9. A. LUCAE, of Berlin. Physiologico-diagnostical contribution to otology. *Berl. klin. Wochenschr.*, No. 32, 1886.

10. Dr. C. ROLLER, Triers. On paracusis Willisii. *Arch. f. Ohrenheilk.*, vol. xxiii., p. 214.

11. Dr. JULIUS ALTHAUS, of London. On tinnitus aurium and its treatment by electricity. *The Lancet*, vol. ii., No. 7, 1886.

12. RICHARD A. D. ROBB, Glasgow. Chloroform vapor in painful ear diseases. *Brit. Med. Jour.*, November 27, 1886.

13. S. S. BISHOP. Cocaine and other anodynes in otology. *Jour. Amer. Med. Asso.*, Feb. 20, 1886.

14. PH. SCHECH. Clonic convulsions of the soft palate, with objective ear-noise following nasal neuralgia of the fifth nerve. *Münchener med. Wochenschr.*, No. 22, 1886.

15. Dr. L. JACOBSON. On the dependence of acuteness of hearing upon the time of hearing. *Arch. f. Ohrenheilk.*, xxiv., No. 1.

16. MAX. SIEGHEIM. Contributions to the knowledge of retinitis pigmentosa, with special reference to etiology. *Inaug. Dissertation*, Breslau, 1886.

17. Dr. C. KELLER, of Cologne. The care of the ears by

the school authorities. *Deutsche med. Wochenschr.*, No. 51, 1886.

18. Prof. VOLTOLINI. Some remarks on parasites in man and the higher mammals. *Monatsschr. f. Ohrenheilk.*, etc., No. 8 and 9, 1886.

1. In the polyclinic conducted by BÜRKNER 1,049 persons with 1,423 different forms of disease were treated in 1885. The operations performed in 123 cases were confined to incision of abscesses and furuncles, removal of foreign bodies, Wilde's incision, paracentesis of the *Mt*, and the extirpation of polypi. S.

2. BRUNETTI's report on the first year of his aural practice in Venice embraces 367 ear-patients, which were seen at his polyclinic for aural diseases from July 4, 1885, to July, 1886.

3. COZZOLINO's book contains his lectures on aural diseases and a clinico-therapeutic formulary. The author describes an ear-douche for continuous ear baths as his own invention, which corresponds to the nasal douche.

4. SCHMIEGELOW has examined the faculty of hearing of 581 school children, aged from 8 to 14 years. He divided the children into three classes: 1. Those hard of hearing: who can hear a whisper only at a distance of less than 2 metres. 2. Those hearing fairly well—at a distance of 2 to 4 metres. 3. Those hearing well—at distance of more than 4 metres.

There were in the first class	35
“ “ “ “ second “	261
“ “ “ “ third “	285

The pathological changes found at the examination of these children present a percentage as follows:

Inspissated cerumen	6 %
Suppuration of the middle ear	2,4 “
(Weil found 1 %, Bezold 0.97 %).	
Chronic rhinitis	25 “
Pharyngitis	24 “
Hypertrophy of the adenoid tissue in the naso-pharyngeal cavity	18 “
Tonsillar hypertrophy	16 “

Among the so-called weak-minded children there were a great many with diminished faculty of hearing.

5. GRAZZI reports several histories of reflex symptoms in the pharynx and larynx caused by dermatitis superficialis diffusa of the external auditory meatus, otomycosis, and the presence of foreign bodies in the meatus. S.



6. The two cases illustrating the two branches of the subject are 1, irritation of the dental nerves in the bone sockets of a child of 14 months ; reflex irritation and suspense of vasomotor inhibition through the otic ganglion, causing dilatation of the tympanic vessels, pressure, and aural pain ; and 2, purulent inflammation of the middle ear in a child  $3\frac{1}{2}$  years old with reflex symptoms simulating pneumonia.

It is the opinion of the authors that the aural lesion of reflex origin has its seat primarily in the upper portion of the tympanic cavity and membrana tympani, and that this can be accounted for by the peculiar distribution of the sympathetic nerves to those parts, which is illustrated by a diagram. Reflex phenomena from the ear to other parts of the air passages are explained as follows : The irritation of the sensitive fibres of the auriculo-pneumogastric distributed in the meatus, and to the *Mt*, and is reflected along the motor fibres of the superior laryngeal nerve, exciting in the larynx the act of coughing. When the original irritant, however, involves the vasomotor fibres associated with the auricular nerve, their impression is conducted to the ganglion of the pneumogastric, and thence reflected through the sympathetic fasciculus to the first cervical ganglion ; thence through the nervi molles to the external carotid, and to the branches of the mucous membrane of the larynx. In illustration is given a case of middle-ear disease, causing laryngeal cough ; also a case of primary implication of the middle ear in pulmonary tuberculosis. The reflex influences of dentition are also considered, and the manner in which they are brought about shown. The reflex connection between the exanthemata is pointed out with an illustrative case.

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7. EITELBERG's patient, with an exudation in the middle ear, and extreme bulging of the posterior portion of the *Mt*, declined to subject himself to the paracentesis. On the evening of the same day he fell into an apathic state, which was considered a paralytic stroke by his relatives. Paracentesis and air-douche removed this condition at once.

8. Whilst Zaufal found ear diseases in 80 % of ozæna patients, Michel, Morell-Mackenzie, Loewenberg, and Moure assert that these complications of ozæna are extremely rare. Wyss has examined 60 cases for this condition ; 13 of these had no ear disease whatever, 32 were diseased in either one or both ears, but without diminution of hearing, and in 15 patients the ear

disease was accompanied by diminution of hearing. These complications were most frequent between the 10th and 30th years of age. In the first of the three above-mentioned classes the discharge was found only at the partition of the nose, not at the lateral walls. In these cases the tuning-fork in Weber's experiment was heard louder in one ear only in three cases. Rinne +, Schwabach's experiment showed 10 to 30 inches only. Acoumeter, whisper, and Galton's whistle, normal. In the second class there were found dulness, partial and complete thickening of the *Mt*, lime deposit in 1 case, and swelling of the *Eustachian* tubes in several others. The tuning-fork placed upon the vertex was heard louder on the diseased side, except in two cases, in which it was heard equally strong on both sides. Rinne +, Schwabach 5-35 inch. in 1 case 50 inch. Acoumeter and whispering weaker on the affected side than on the healthy one, but still normal. In two cases the upper limit was with Galton's whistle somewhat lower. The third of the classes mentioned above contain cases of acute catarrhal, purulent, and chronic dry middle otitis and inflammation of the labyrinth. In 6 cases the nasal disease was more pronounced upon one side than upon the other. In these the ear was diseased only upon the corresponding side. The ear diseases relapsed often, or had a chronic progressive character like the *ozæna* itself. There were often subjective noises; rarely pain or dizziness. A part of this class heard whispering normally, but the acoumeter showed a decreased hearing. The upper limit of Galton's whistle was in several cases abnormally low. In Weber's experiment the tuning-fork was better heard in the diseased ear. Schwabach 10-32 inch.; in two cases 45 inch. Schwabach's experiment therefore showed of 60 cases only 3 approximately normal, wherefrom the author infers that the nasal cavity of the *ozæna* patients loses its proper resonance on account of the discharge. The treatment of the aural diseases accompanying *ozæna* does not differ from the usual treatment.

9. As the inspection of the *Mt* does not give positive information as regards the tension, LUCÆ uses the insufflation noise of the meatus for the examination of the tension. He blows with the mouth into a small rubber tube placed in the ear, taking care not to blow too strongly, because the noise is thereby increased. Stronger tension of the *Mt* intensifies considerably the insufflation noise; dulness and even lime deposits

do this to a lesser degree. Less frequently the noise is deepened, at least when the *Mt* is preserved, namely, most frequently in cases of large flabby cicatrices; the deepening is increased when the *Mt* is destroyed. Diagnostically only large differences in pitch are available, as some sources of error cannot always be avoided. The author examined a patient who could contract voluntarily the tensor tympani musc. with which motion the anti-tragus was regularly approached to the tragus. When the tensor tympani was contracted the insufflation noise was increased. Lucae found also that the same patient heard the deeper sounds of the tuning-fork very much deadened when the *Mt* was tense, whilst the high notes became prominent, and *c'* was increased by the tension. This intensification of the high notes and of *c'* was also noticeable objectively.

10. ROLLER reports a case of paracusis Willisii, in which inspissated cerumen was found in the external meatus, and which was cured by its removal, in support of Politzer's supposition that this trouble may be caused by the arrested motion of the ossicles. Accordingly the author recommends the use of LUCAE'S pressure-probe. S.

11. A case of tinnitus aurium in which the auditory nerve examined galvanically, after Brenner-Erb's method, proved to be in a state of simple galvanic hyperæsthesia, was permanently cured by ALTHAUS in ten sittings, by the application of rational galvanic treatment. S.

12. ROBB reports excellent results gained with vapors of chloroform in cases in which the patients complained mainly of unbearable pain. In cases of furuncle, otitis externa, diffuse and acute inflammation of the *Mt*, the pain was relieved to such an extent that the patients considered themselves cured. In many cases the pain did not return, in others all the necessary manipulations could be accomplished without causing the patient any pain. Also in cases of otalgia, without visible local signs. Robb found the vapor to be very efficient. When using the vapor the introduction of the chloroform itself into the ear must be avoided. H.

13. SCHECH examined an extremely anæmic patient who, after an injury to the nose through a fall in his sixth year, had in his twentieth year acquired a neuralgia of both sides and all branches of the fifth nerve, with clonic convulsions of the musc. levator and tensor veli palati and the azygos uvulæ, which at time of writing had existed for about three years. The soft palate was drawn

upward 40 to 100 times in a minute, with short interruptions. At the same time the anterior lip of the tubes approached and receded from the posterior one, and a cracking noise was objectively noticeable. The root of the nose was the most tender spot to pressure, but the pain could be also largely increased by pressure upon the other points of exit of the branches of the fifth, on many other points of the face, and on the nerv. laryngeus superior.

Besides abnormal width of the ridge of the nose, nodular scars of the skin, hypertrophy of the mucous membrane, deviation of the septum, etc., the author found that the bone of the right lamina perpendicularis and of the upper median portion of the left middle turbinated body laid bare, no signs of syphilis were discoverable. Iodide of potash was prescribed without success; cocaine, morphia, and arsenic without effect. An operation could not be considered on account of the bilateral location and the evident dyscrasic character of the disease. Of late frequent epistaxes accompanied the described condition. H.

14. SIEGHEIM found among the 73 cases of retinitis observed by Magnus five associated with deaf-mutism and six with hardness of hearing. According to Leber the ear trouble accompanying the pigmentous degeneration of the retina is most frequently congenital, but certainly of later development in several instances. It may precede the retinal disturbance. In other cases pigmentous degeneration of the retina is added later to the congenital deafness, or both appear at birth. The brothers and sisters may in addition to the retinitis pigmentosa be also affected with deaf-mutism or hardness of hearing. The author believes that the influence of consanguinity, upon closer investigation, will prove to be purely accidental, namely, that it will show itself in families which are already affected with a similar affliction. Among the 73 cases heredity was found in 17, consanguinity of the parents in 9. The relations between the retinitis pigmentosa and the deaf-mutism are composed as follows: (a) retinitis pigmentosa and congenital deaf-mutism are conditions closely allied; (b) both are hereditary in a high degree, namely, they may be transmitted as such or give birth to organic diseases in the descendants, the ectoderma being considered as the embryogenetic foundation; (c) with regard to the complications which are found with retinitis pigmentosa or deaf-mutism, only those organs are affected which develop from the ectoderma. H.

15. KELLER collates the various examinations of school children, as regards hardness of hearing, which have been made up to date by physicians (v. Reichard, Weil, Sexton, Moure, Gellé, Bezold), with the uniform result that 10 to 30 per cent. of the children were hard of hearing. The inquiries made by the school authorities at the request of the Prussian ministry for public instruction showed only 2.18 per cent. of the number of pupils to be affected. Keller believes it to have been a mistake of the administration for instruction to have discarded medical advice. H.

16. In addition to the presence of an *acarus* (a new species of *dermatonypos*) observed by himself in the ear of the adult cattle, VOLTOLINI compares the cases published by other authors, in which *Sarcophila Wohlfartii* was found in the auditory meatus and in the nose. The danger caused by the maggots of that insect when it enters the nose, is illustrated by the patient's history. The destructions produced in this case by the maggots in the nose and the nasal cavities, caused the death of the patient referred to. S.

## INSTRUMENTS AND APPARATUS.

17. Dr. T. PINI, Milan. Il catetere pneumo-elettrico Eustachiano. *Gazz. degli Capitali*, No. 14, 1886.

18. Dr. SCHUBERT, Nuremberg. A galvanocauter for the membrana tympani. *Arch. f. Ohrenheilk.*, vol. xxiv., p. 47.

19. Dr. RATTEL, Paris. Des cornets acoustiques et de leur emploi dans le traitement médical de la surdimutité. Ballière et fils, 1886.

20. Dr. BÜRKNER, Göttingen. The availability of Auer's incandescent gaslight for medical purposes. *Berl. klin. Wochenschr.*, No. 48, 1886.

17. Description of a new *Eustachian* catheter, available at the same time for the execution of electric procedures in the *Eustachian* tube and the tympanic cavity, and also for the air douche. S.

18. SCHUBERT recommends, in place of the usual pointed burners, making only a round and comparatively small perforation, a burner 3 mm long, devised by himself, the cutting edge of which is placed vertically to the handle, which produces larger openings in the *Mt.* The inclination of the burner to the handle

must be adapted to the inclination of the *Mt*, which varies according to age and individuality. S.

19. RATTEL's monograph, after an historical introduction, describes a great number of hearing tubes variously recommended. The varieties and the number of the instruments prove that the problem of the prothesis for the ear has not been solved as yet. The indication for the employment of hearing-tubes exists in most of the diseases of the conducting apparatus. In affections of the nervous apparatus they are inapplicable. The severer the lesions in the ear are the larger must be the apparatus, and the conductivity of its material must be greater. Various experiments must be made in order to find a suitable tube. H.

20. BÜRKNER recommends especially for examination of the ear and nose Auer's incandescent gaslight; a cotton tissue, impregnated with nitrates of Cer, Yttrium, Didym, Lanthan, etc., glows in a Bunsen burner. Advantages: white, bright, steady light, slight heat, expenses small, amount of consumed gas half as much as with the ordinary burners. H.

#### EXTERNAL EAR.

21. DR. MÉNIÈRE. Epaissement hypertrophique des deux pavillons des oreilles. *Bull. et mémoires de la Soc. Franç. d'Otologie*, etc., vol. iv., p. 42.

22. W. C. PIPNIO. Naevus vascularis maternus. *Med. Record*, October 16, 1886.

23. THOMAS R. POOLEY. A case of epithelioma of the auricle, *Med. Record*, November 20, 1886.

24. DR. SHIRMUNSKI, St. Petersburg. A case of complete cicatricial closure of the aural introitus. Restitution of opening and hearing. *St. Petersb. med. Wochenschr.*, 1886, No. 34.

25. I. E. MURRELL. Black cerumen. *Journ. Amer. Med. Assoc.*, October 2, 1886.

26. G. DOBNEY. Furuncle of the external ear. *Progress*, July, 1886.

27. Prof. JOSEF GRUBER. On the occurrence and significance of yellow spots on the membrana tympani in the vicinity of the end of the handle of the malleus. *Monatsschr. f. Ohrenheilk.*, etc., 1886, No. 7.

21. MÉNIÈRE observed in a man, 34 years old, without syphilitic or other diathesis, a hypertrophic thickening of both auricles;



which developed on both sides during the last two years. There were no signs of inflammation. H.

22. The growth was on the helix of the right ear, and it began to enlarge rather rapidly after the first year. Electrolysis was tried without avail, and it was finally removed by the knife. It measured  $2\frac{1}{8}$  by 1 inch, and was  $\frac{5}{8}$  inch thick. The mother stated that when carrying the child she had occasion to separate a dog from an old sow's ear, which was lacerated and bleeding.

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23. The patient was a man who first noticed some scales on his right ear, five years before the operation, following a frost-bite. The "wart," which gradually formed after this, was removed by a physician at the beginning of the fifth year, and pronounced, after examination, to be non-malignant. At the time P. saw him there was rather a deep, ragged-edged ulcer on the anti-helix,  $\frac{1}{2}$  by  $\frac{3}{8}$  inch in size. The submaxillary glands were enlarged. The growth was enclosed in an entropium forceps, cocaine injected subcutaneously, and the whole diseased tissue removed. There has been no return of the growth now two years since the removal. S. M. B.

24. SHIRMUNSKI reports a case of a female patient, 21 years of age, in which membranous occlusion of the external meatus occurred after scarlatinous otorrhœa in childhood. A previously-performed operation had proved unsuccessful. The introitus, when examined, was found to be occluded by a radiating cicatricial membrane. When touched with the probe, the membrane appeared to be somewhat yielding in the centre. The examination of hearing showed that the labyrinth could not have been changed to a great extent. The operation was performed with a pointed bistouri, which had to penetrate the cicatricial tissue 5 to 6 mm in order to reach the extremely narrowed lumen of the meatus. A transverse incision was added, and at last the cicatrix was destroyed with the galvano-cautery. After gradual dilatation with tents during two weeks, a speculum of medium size could be easily introduced. Thickened masses of epidermis and pus were removed from the meatus. A small perforation with granulations was cured with chromic acid. A small rubber tube had to be introduced a few weeks longer, in order to prevent reunion, until complete healing had taken place with a permanent opening.

H.

27. The cerumen was soft like treacle and as black as tar.

There were no vegetable spores found in it under the microscope nor any pigment granules. The coloring matter seemed to be of a soluble nature. The ears appeared to be healthy. No explanation is attempted. S. M. B.

28. The patient, a man of fifty-nine years, had suffered great pain for several days from a furuncle in the left meatus. It was incised and a few drops of pus were discharged. A few moments thereafter he became dizzy, then unconscious and delirious, and went into tonic convulsions consisting chiefly of opisthotonos. By the next morning he had recovered. He reported that he had had a few "fits" after an injury to the head in childhood, but none since. S. M. B.

29. GRUBER describes yellow spots near the lower extremity of the handle of the malleus, which must be differentiated from those which occur normally and must be considered as pathological lesions of the membrana tympani. These may arise from the collection of a colloid-like fluid which has settled in a small quantity between the layers of the *Mt*, and they are then disc-like or of less regular outlines. Besides this, spots may also indicate the formation of folds in this part of the *Mt*, together with partial relaxation of the membrane. Both forms of yellow spots are observed by the author only in cases of sclerosis in the middle ear with extreme retraction of the *Mt*. S.

#### MIDDLE EAR.

30. S. S. BISHOP. Cocaine and other anodynes in otology. *Journ. Amer. Med. Assoc.*, Feb. 20, 1886.

31. C. H. BURNETT. The local use of cocaine and brucine in diseases of the ear. *Trans. Amer. Otol. Soc.*, 1885.

32. W. A. BARTLETT. The effect of sea-bathing on the ear. *Med. Record*, Aug. 28, 1886.

33. GORHAM BACON. Two cases of ear diseases due to traumatism. *Trans. Amer. Otol. Soc.*, 1886.

34. Dr. GELLÉ. Trois cas d' otite hémorrhagique. *Revue mens. de laryngol. etc.*, No. 12, 1886.

35. ALBERT H. BUCK, New York. On painless or only slightly painful ulceration and perforation of the membrana tympani, probably of a tubercular nature. *New York Med. Jour.*, Aug. 21, 1886.

36. BROOKS. A case of pent-up pus in the tympanic cavity. *Brit. Med. Jour.*, December 11, 1886.
37. SAMUEL SEXTON. The diagnosis and treatment of acute and chronic purulent inflammation of the middle-ear tract and their complications. *Trans. Amer. Otol. Soc.*, 1886.
38. S. S. BISHOP. Operations on the drum-head for impaired hearing, with fourteen cases. *Four. Amer. Med. Assoc.*, August 28, 1885.
39. HUNTINGTON RICHARDS, New York. A singular case of mastoid disease, spontaneous perforation in an unusual situation. *Med. Record*, December 11, 1886.
40. B. GOWERS and E. BARKER (University College Hospital) London. On a case of abscess of the temporo-sphenoidal lobe of the brain due to otitis media successfully treated by trephining and drainage. *Brit. Med. Jour.*, December 11, 1886.
41. W. H. BAKER. Otitis media. *New York Med. Jour.*, November 13, 1886.
42. C. H. BURNETT. Two cases of chronic purulent inflammation of the tympanic attic, treated with peroxide of hydrogen. *Trans. Amer. Otol. Soc.*, 1886.
43. SAMUEL SEXTON. A new operation for the radical cure of chronic purulent inflammation of the middle-ear tract. *Trans. Amer. Otol. Soc.*, 1886.
44. M. BONNET. Otite purulente après un accouchement. Phlébite des sinus. Pyohæmie. Mort. Autopsie. *Annales des malad. de l'oreille*, etc., No. 9, 1886.
45. O. D. POMEROY. A case of abscess of the mastoid cells where the main indication for operation was elevated temperature. *Trans. Amer. Otol. Soc.*, 1886.
46. Dr. I. W. HULKE, London. Trephining for evacuation of intracranial abscess occurring in connection with suppurations in the ear. *The Lancet*, vol. ii., No. 3, 1886.
47. A. LUCÆ and L. JACOBSON. Hundert Fälle von operativer Eröffnung des Warzenfortsatzes (A hundred cases of operative opening of the mastoid process). *Berl. klin. Wochenschr.*, 1886, No. 38.
48. Dr. H. BIRCHER, Aarau. Zur Eröffnung des Warzenfortsatzes (On the opening of the mastoid process). *Correspondenzblatt f. Schweizer Aerzte*, 1886.

49. Dr. M. GRÖNLAND, Copenhagen. Resectioner of processus mastoideus for suppurativ otitis media. *Hosp. Tidende*, vol. iii., p. 653.

50. ALBERT H. BUCK, New York. On certain technical details relating to the mastoid process and the after-treatment. *Trans. Amer. Otol. Soc.*, vol. iii., part 5, p. 623.

51. H. KNAPP. Fatal termination after chiselling of the bone in a case of sclerosing mastoiditis. *Trans. Amer. Otol. Soc.* 1886.

52. Dr. WEINLECHNER, Vienna. Osteoma in the mastoid region removed by operation, etc. *Monatsschr. f. Ohrenheilk.*, etc., 1886, No. 11.

53. Dr. NOQUET, Lille. Crises epileptiformes provoquées par une otite moyenne chronique simple. *Revue mens. de laryngol.*, etc., No. 7. 1886.

30. The author reports that he has been able to subdue the pain of acute otitis media with an intact membrane, by instilling a 4 % solution of cocaine into the meatus and allowing it to remain in contact with the membrane for five minutes. The pain, he says, seldom returns after the first application.

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31. The author has not found the sulphate of cocaine of any value in relieving the pain of otitis media or externa. The hydrochlorate has been somewhat efficacious, but only in superficial congestion of their tissues. He has used brucine in several cases, however, with decided relief to the pain, and particularly in otitis externa, it apparently anæsthetizing the skin more promptly than the mucous membrane. He used it in 5 % solution.

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32. Of seven acute cases presenting at Dr. SEXTON's clinic all were males. In four the ears had been injured by water passing into the middle ear *via* the *Eustachian* tube. In the others, the injury came from the water entering the external meatus. In five cases the inflammation was limited to the attic of the tympanum and contiguous parts, and there was no discharge from the ears. It is advisable for bathers to put some cotton in the external meatus before going into the water.

S. M. B.

33. Case I. Injury to membrana tympani from the twig of a tree. Case II. Pistol-shot wound of the right mastoid process. The bullet entered the mastoid and lodged against the posterior

wall of the external meatus, causing it to bulge forward and to necrose. Some spiculæ of bone were removed through the meatus, and the mastoid was trephined, and an attempt was made to extract the ball; as the patient behaved badly under the ether it had to be abandoned. A second attempt was not made. The patient disappeared from view, but his hearing-power had increased, and the wound in the mastoid made with the trephine had quite healed.

S. M. B.

34. GELLÉ reports three cases of hemorrhagic otitis which followed a severe inflammatory course from beginning to end. In all three cases the inflammation was associated with epistaxis. Gellé thinks it to be quite possible that blood enters the middle ear through the *Eustachian* tubes during the epistaxis. This hemorrhagic attack may also arise both in the ear and in the nose.

H.

35. BUCK makes, from three observations, the following conclusions concerning the characteristic appearances of tuberculous inflammation in the middle ear in the first stage: 1. The tendency of the process to localize itself near the upper and posterior portions of the *Mt.* 2. Marked insignificance of pain, or even its entire absence. 3. The intolerance of any but the simplest and gentlest local remedies.

H.

36. BROOK's patient suffered since childhood from scarlatinous otorrhœa; fever, intense headache, dizziness, and temporary loss of consciousness ensued. After his admission to the hospital the patient was without consciousness for a week, and in addition a facial paralysis supervened. Field was consulted. After removal of a large polypus a considerable amount of pus was discharged from the tympanic cavity, with immediate relief of the symptoms. The facial paralysis disappeared the following day.

H.

37. In these statistics there are included 2,366 cases, selected from over 20,000 cases. Of these, 739 were acute purulent inflammation, 245 acute catarrhal inflammation, and 1,382 chronic purulent inflammation. The principal active causes of the acute purulent cases were: syphilis in 7 cases, sea-bath in 75, traumatism in 34, maltreatment of chronic purulent inflammation in 34, exposure in 27, exanthemata in 19. In the acute catarrhs the active causes were: syphilis in 3 cases, sea-bath in 48, traumatism in 15, exposure in 9, exanthemata in 8. In the chronic purulent cases the active causes were: syphilis in 23 cases, sea-bath in 81,

traumatism in 27, maltreatment in 15, exposure in 7, Turkish-bath in 3, exanthemata in 189, vaccination in 2, diphtheria in 8, croup in 1, small-pox in 2, pertussis in 4, parotitis in 1, typhoid-fever in 3, pneumonia in 1.

Among these cases there were 119 cases of mastoid disease in the acute cases, and 71 in the chronic cases. In 131 cases of acute and chronic suppurative inflammation of the middle-ear tract, there was periostitis interna or externa, or both, with caries of the auditory plate, and mastoid antrum, and other grave complications. Of these, 12 terminated fatally. A synopsis of these fatal cases is given. This is followed by some remarks on the anatomy of the ear, giving Prof. Leidy's latest investigations on that part of the temporal bone belonging to the middle ear. Some space is given to the question of trephining the mastoid process. The author, as is well known, is much averse to this operation, maintaining that it is easier and better to obtain the proper discharge of the mastoid cavity through the external auditory meatus.

S. M. B.

38. A piece of the *Mt* was taken out, but in no case were the ossicles removed, and they were all cases of chronic non-suppurative catarrh. In none was any evil result experienced, though in three, suppuration of the middle ear followed the operation. The improvement in hearing was not great in any case, but nearly all expressed themselves as hearing better.

S. M. B.

39. RICHARDS' patient, after a cold, acquired an inflammation of the middle ear, involving the mastoid process. A small perforation of the membrana tympani had to be enlarged repeatedly, and Wilde's incision was employed. Gradually a swelling, soon presenting fluctuation, developed behind the mastoid process at the connection with the occipital bone; pus was discharged from the opening of the *Mt* upon pressure on the swelling. After the incision a great deal of pus was discharged, and injected fluids passed through the nose. The probe entered the mastoid process through thin osseous layers. The injections were followed by headache and vomiting. Gradual improvement. Cure eighteen days after the incision.

H.

40. GOWERS and BARKER report an extremely important case of a patient, nineteen years old, affected since childhood with an otorrhoea of the right side, which had developed after scarlet-fever. In August, 1886, pain began in and around the ear with disorders of the general health; at the beginning of September



signs of fever. At the admission to the hospital (September 15th) no disorder of the central nervous system existed, but bilateral neuritis optica. Offensive suppuration from the ear. In the membrana tympani a large perforation existed anteriorly above; firm, foetid, cheesy masses behind it; no signs of inflammation. Gradual increase of the neuritis. September 25th slight dazed condition, vomiting, unequal pupils, no headache; September 28th chiselling of the mastoid process, irrigation towards the external meatus, removal of cheesy masses. The general symptoms improved after the operation, there remained different reaction of the pupils and increase of the neuritis optica. The fourth day after the operation vomiting set in again, increasing stupor, sleepless nights, delirium, when syringed nystagmus to the left on both sides, higher fever with chills. On October 3d it was decided to search for an abscess in the temporal lobe;  $1\frac{1}{4}$  inches behind and  $1\frac{1}{4}$  inches above the centre of the external meatus (at the lower posterior angle of the parietal bone, near the squamous suture) the skull was opened with the trepan. The dura mater and the surface of the brain were both found normal. The wound was washed with a strong solution of carbolic acid and dusted with iodoform. An aspiration needle was then introduced into the temporal lobe, taking an inward, forward, and downward direction. When the needle had entered about one half inch from the surface of the brain, a peculiar noise, produced by the escape of a gas bubble, was heard, followed by the discharge of  $4\frac{1}{2}$  drs. of thick, yellow, and very offensive pus. After removal of the needle the opening was enlarged with forceps and 2 to 3 drs. more of pus were discharged. The brain cortex was then removed with Volkmann's spoon to the extent of the size of the external opening. Introduction of a rubber drainage tube, two inches long, dusted with iodoform, dressing with iodoform gauze. During the operation no nervous symptoms appeared. Respiration impaired once, but improved with the escape of the pus from the abscess. At the same time the pulse rose to 150. The after-treatment consisted in regular irrigations with solution of boric acid, a silver drainage tube being later substituted for the rubber tube. After the operation rapid improvement of all symptoms; improvement of the optic neuritis. The day following the operation the pus escaping from the abscess cavity had lost its offensive smell. Two weeks after the operation the drainage tube was omitted and the patient allowed to get up, and

November 12th was discharged from the hospital completely cured.

BARKER lays much stress for the success of the operation upon the previous thorough disinfection of the middle ear and its accessory cavities. In order to determine whether the seat of the intracranial suppuration is in the cerebrum or in the cerebellum, BARKER during the operation searched for the foramen of the vena mastoidea, in the belief that the pus when perforating towards the posterior surface of the petrous bone has first to form a layer between dura mater and petrous bone, from which pus escapes through the foramen mastoideum. H.

41. The author inveighs against the new operation (removal of the ossicles) for "the radical cure of otitis media." In a series of fifty cases of all forms and severity he has found boric acid almost a specific. S. M. B.

42. The first case was that of a man thirty-seven years old, who had at intervals for four years been under observation and treatment for attic disease, the *Mt* being intact below Shrapnell's membrane. The usual methods of treatment did not seem to make any permanent impression on the diseased condition. Finally the peroxide of hydrogen was used as a cleanser, and the condition has vastly improved, and the hearing power has increased from 0 to 3 feet for the voice.

In the second case the *Mt* was gone, but the roof of the attic was diseased. The cleansing of the parts with the peroxide and application of a carbolic acid solution of 5 % caused a cessation of the discharge, which had existed pretty constantly since childhood. S. M. B.

43. This operation consists in cleaning out the tympanum of all the remains of broken-down tissue, particularly the membrana flaccida and the contents of the attic. The malleus and the incus when detached are also removed. A knife and some scrapers used in the operation are figured. S. M. B.

44. BONNET. Still-birth; mother well, then rigors with perspiration and intense headache. In the evening violent pain in the left ear and mastoid process. The following days continuous chills, repeated epistaxis, purulent discharge. Wilde's incision. Chills become irregular, the temperature rises to 42.2°. Death ensues 23 days after the first chill. The post-mortem examination reveals a large abscess and several small miliary ones in the lung. In the cranial cavity no pathological changes except congestion

were found in the brain and the meninges. The left lateral sinus shows yellow-green discoloration ; its contents are transformed into a pus cavity. No suppuration in the mastoid process. The author considers the inflammation of the middle ear as the part primarily infected from the uterus, whilst the sinus and the lung are supposed to be affected secondarily from the ear. H.

45. The patient, a man of 20, had acute otitis purulenta media. Soon after cessation of discharge there was a sudden elevation of temperature ( $103\frac{3}{4}^{\circ}$ ), some slight tenderness over the mastoid, but no swelling or redness. It was decided to perforate. The external layers of bone were healthy, but the drill finally struck a cavity containing 5 or 6 drops of thick pus. All the unpleasant symptoms immediately subsided. S. M. B.

46. HULKE, on account of his latest experiences on the seat of brain abscesses following suppurations of the middle ear, believes that in young individuals the abscess is located more frequently above the tentorium cerebelli, in older persons below this. Hemiplegia and hemispasms are in favor of the upper location, symptoms of pain being absolutely unavailable for the differential diagnosis. S.

47. Among the 100 operated patients 57 were cured, 31 remained not cured (partially improved), 12 died, one of them independently of the ear disease. In no case did death ensue in consequence of the operation. In all, 16 were operated for acute inflammation of the mastoid process without cutaneous abscess, 37 for subcutaneous or subperiosteal abscesses, 41 for fistulæ of bone, 24 for fistulæ of bone and skin, 23 with apparently healthy mastoid process ; in 25 cases an *indicatio vitalis* was present—8 of these 25 died. The operation was made with chisel, hammer, and sharp spoon exclusively. The sinus transversus was laid bare in 8 cases without injury, the dura mater in 1 case. The after-treatment consisted in irrigation of 1-2 % solution of carbolic acid, plugging with iodoform gauze, and draining with small rubber—and later lead—tubes. H.

48. Mastoiditis is rarely, although occasionally a primary disease. BIRCHER observed 3 such cases running a favorable course without operation. In secondary inflammation the acute and the chronic are to be distinguished from each other, and practically the simple retention of pus ranks equally with these. In operating, an incision in the skin is made 1 cm behind the auricle. This incision often meets with a subperiosteal abscess. But in almost

all cases there is another abscess at the bottom which must also be opened. After removal of the pus the wound is disinfected, drained, cutaneous wound sewed, and every second or third day irrigated with disinfecting fluid. The dangers of the operation consist in injury to the facial nerve, the transverse sinus, and the opening of the cranial cavity. The injury to the facial may lead to permanent lesions. The opening of the cranial cavity, with careful antisepsis, is without danger. The injury to the transverse sinus is the most dangerous, but often even this is without ill effect. In one case the sinus was opened by BIRCHER without detrimental consequences. H.

49. The operations were performed in the municipal-hospital in Copenhagen, ten by Prof. Studsgaard, one by DR. E. Tscherning, all with excellent result. In one case the transverse sinus was opened, the bleeding was stopped by compression; from the same patient—a girl, two years old—a piece of the labyrinth was removed through the operation wound.

50. The author points out what he considers to be the superiority of the drill over the chisel or gouge in perforating the mastoid. He thinks that chisels require more skill, that they produce a larger area of depressed bone, and that statistics do not show that the chiselling is followed by any more favorable results. He gives in addition the detailed history of 24 operations of this character, 8 of which have not been hitherto published. S. M. B.

51. The patient was a man 50 years old, and the operation was performed for sclerosing mastoiditis. He died on the 4th day after the operation, with what the author believes to have been a traumatic meningitis. No autopsy. In his opinion, the operation is not advisable in cases where it is likely that old suppurative disease has locked up inaccessible foci of old, decomposed pus.

S. M. B.

52. WEINLECHNER removed with hammer and chisel an ivory osteoma, weighing 30 grms., from the mastoid process of a woman, 30 years old. During operation the mastoid cells were opened, whereupon a suppurative otitis media with perforation of the membrana tympani set in, which did not prevent a complete healing with recovery of the normal hearing faculty. S.

53. NOQUET, in a patient, 41 years of age, suffering for more than a year from frequently returning epileptic attacks, found hardness of hearing on one side without patient being aware of it. This was due to chronic simple catarrh of the middle ear,

with retraction of the *Mt* and of exudation in the tympanic cavity. Suitable treatment cured the ear disease and relieved the patient from his epileptic attacks. H.

## NERVOUS APPARATUS.

54. DR. DÉLIE D'YPRES. Surdit  et logopl gie par suite d'un coup sur la r gion occipitale. *Revue mens. de laryngol.*, etc., 1886, No. 10.

54. DÉLIE's patient, 13 years of age, after a severe blow with a stick upon the occiput, was without consciousness for two minutes; from that time did not talk any more, and was completely deaf. There existed no headache, no disorder of vision, no giddiness, no vomiting, nor tinnitus. Clear intelligence, excellent memory. Patient answers written questions in the same manner or by signs. Simulation could be excluded. A week after the injury, improvement of the hearing, which gradually increased. Two months later the patient fell into the water, whereupon the speech returned. After three days the hearing also was completely restored. H.

## NOSE AND NASO-PHARYNX.

55. E. CRESWELL BABER. Examination of the nasal cavities from the front. *British Med. Jour.*, Dec. 11, 1886.

56. DR. A. HEDINGER. Ueber Rhinochirurgie (On nasal surgery). *W rttemberger med. Correspondenzblatt*, 1886, Nos. 32-34.

57. DR. ANTONELLI. Il sublimato corrosivo nella rinite ulcerativa. *Bolletino delle malattie dell' orecchio*, 1886, No. 5.

58. DR. A. HOLM, Copenhagen. Nogle Tilf lde of anosmia syphilitica. *Hosp. Tidende*, vol. iv., p. 649.

59. DR. KRIEG, Stuttgart. Resection der cartilago quadrangularis septi narium zur Heilung der Scoliosis septi (On resection of the quadrangular cartilage of the nasal partition for the cure of deviation of the septum). *W rttemberger Med. Correspondenzblatt*, 1886, No. 28.

60. DR. WOLTERING, M nster. Operation einer kn chernen Nasenverengerung mittelst schneidender Knochenzange (Operation of an osseous nasal stenosis by means of the cutting bone-forceps). *Monatsschr. f. Ohrenheilk.*, 1886, No. 10.

61. DR. SCHMIEGELOW, Copenhagen. Reflex neurosernes Forhold til Sygdomme in N sen og Sv lget. *Nord. med. Arkiv.*, vol. xvii., p. 27.

62. Dr. ZIEM, Danzig. Ueber neuralgische und nervöse Begleiterscheinungen bei Nasen- und Rachenkrankheiten (On neuralgic and nervous complications in diseases of the nose and pharynx). *Monatsschr. f. Ohrenheilk.* 1886, Nos. 8 and 9.

63. Dr. L. LICHTWITZ, Bordeaux. Des zones hystérogènes observées sur la muqueuse des voies aériennes supérieures et des organes des sens. *Revue mens. de laryngol.*, etc., 1886, No. 12.

64. Prof. VOLTOLINI, Breslau. Ueber electrolytische Operationen mit Demonstration von Instrumenten (On electrolytic operations with demonstration of instruments). *Monatsschr. f. Ohrenh.*, 1886, No. 10.

66. Dr. GELLÉ. Epistaxis grave, tamponnement postérieur. Otites suppurées bilatérales. *Revue mens. de laryngol.*, etc., 1886, No. 12.

66. Dr. SCHMIEGELOW, Copenhagen. Quelques cas assez rares de perforations de la cloison nasale. *Revue mens. de laryngol.*, etc., 1886, No. 11.

67. EDWARD BOVILL. A case of rhinolith. *British Medical Jour.*, Oct. 16, 1886.

68. HENRI CHATELLIER. Note histologique sur deux tumeurs muriformes de l'extrémité pharyngienne des cornets inférieurs. *Annales des malad. de l'oreille*, etc., 1886, No. 8.

69. HENRI CHATELLIER. Note sur un cas d'hypertrophie de la muqueuse nasale. *Ibid.*, 1886, No. 9.

70. Dr. ALBERT CLAVERIE. Études sur les tumeurs malignes primitives des fosses nasales. Bordeaux, 1886.

71. E. S. MOURE. Sur un cas de fibrosarcome primitif de la fosse nasale droite. *Revue mens. de laryngol.*, 1886, No. 8.

72. Prof. DUBREUIL, Montpellier. Polype naso-pharyngien. *Gaz. médicale de Paris*, 1886, No. 45.

55. In order to facilitate the nasal examination from in front, and to fix its results more easily, BABER gives drawings of the conditions found, of which five are found in the publication in question. BABER believes that a much better conception of the condition found in anterior rhinoscopy is given by the drawings in connection with remarks, than by an extensive description.

H.

56. HEDINGER in his lecture discusses mainly the catarrhal diseases in the nasal cavity, with their complications. In acute



coryza, in himself or in others, he did not observe any effect from cocaine. In the first stage of chronic catarrh, especially with extensive dryness of the nose, insufflation of nitrate of silver in very small doses has proved extremely valuable. In considerable swellings of the nasal mucous membrane chromic acid or the galvano-cautery are employed—the former in slight, non-inveterate cases, the latter in large hypertrophies, polypoid degeneration, or swelling of the turbinated bodies. In the second half of his lecture HEDINGER discusses the reflex neuroses and accepts HACK's standpoint with regard to the most important points.

H.

57. ANTONELLI reports a case of ulcerative rhinitis, resisting other remedies, cured by the application of a sublimate salve (0.01 by 10.0 vaseline) within a short time. S.

58. Three cases of anosmia in syphilitic patients. The author supposes two to be produced by intracranial lesions; in the third ulcerations and necrosis were present in the nose. V. BREMER.

59. KRIEG, in reference to the etiology, distinguishes the deviations of the nasal partition produced by elongation from those by luxation. The causes given are unequal growth of the bones, sleeping on one side, and injuries. Among the consequences of scoliosis the author mentions, besides the usual consecutive appearance, an empyema of the antrum Highmori, observed three times in himself on the narrowed side. He supposes that reflex troubles may probably be caused by the deviation. Krieg considers partial resection the best procedure for the treatment of the deviations.

H.

60. WOLTERING, by means of a cutting bone-forceps devised by him, removed a shell of bone which, originating from the septum at the proc. palatinus of the upper jaw and the lower margin of the vomer, filled up the whole half of the nose. S.

61. SCHMIEGELOW describes the reflex neuroses of the nose and the throat elaborately and with careful reference to the literature. Among his observations the spasms are the most frequent. Bronchial asthma—principally with nasal polypi, 9 times among 40 cases,—cough, sneezing attacks, and laryngeal spasms. Among the sensory neuroses those found in the region of the fifth nerve are especially mentioned; among the vasomotor ones erythema of the nose and the cheeks.

V. BREMER.

62. ZIEM, after trying to define precisely the causes of the concomitant neuralgias in nasal and pharyngeal diseases, opposes

the view that these might originate from the uninjured mucous membrane itself. The neuralgias are due, he believes, to ulcerative processes of the mucous membrane laying bare nerve fibres, or, more frequently, to an affection or an occlusion of the accessory cavities, especially of the frontal cavities, by means of the swelling of the nasal mucous membrane. Hence the necessity of stating in these cases whether the frontal cavities are free or not. The pressure in the vertex, which is often felt in chronic nasal obstruction, may be effected by the closure of the cranio-nasal emissary vessel, in consequence of which the proximate parietal emissary, which is situated backwards, becomes congested. This may also be the result of a diminution of conductivity in the nasal lymph paths, which serve as an outlet for the cerebro-spinal fluid.

S.

63. The observation that a vehement convulsive attack could be produced by touching the epiglottis of an hysterical patient, induced LICHTWITZ to make further investigations. In six other hysterical patients, besides other zones, some were also found in the nose, from which convulsions could be produced. They were bilateral five times; unilateral once. In two cases cocaineization produced abolition of the irritability. Lethargic and hypnotic zones may exist in addition to "spasmogenetic" ones. "Hysterogenetic zones" were found in the nose, mouth, pharynx, and larynx. Lichtwitz points to the fact, that these "hysterogenous zones" must be known, in order to be prepared for unpleasant accidents in operations.

H.

64. In the surgical section of the meeting of naturalists in Berlin, VOLTOLINI demonstrated electrolytic forceps and pincettes and a new electrolytic cutting-loop, devised by him, for the removal of fibrous and fibro-sarcomatous tumors of the nasopharyngeal cavity, also explaining the advantages of electrolysis.

S.

65. GELLÉ attacks the general opinion, that death ensues after a posterior nasal tamponade in consequence of cerebral apoplexy, pointing to the fact that the consecutive acute inflammation of the middle ear may be the cause of the fatal issue in a number of cases. Gellé reports the case of a man, 55 years of age, in whom the posterior nares had to be plugged on account of severe epistaxis; the plug remained for 48 hours. Three days after its removal, vehement acute bilateral otitis media developed with perforation of the membrana tympani. Cure in three weeks.

The inflammation is produced by irritation of the middle ear by the putrid fluid caused by the plugging. Gellé and his colleagues taking part in the discussion on this lecture are apparently not familiar with the *Reviewer's* account of the dangers of the posterior plugging and its substitution by local arrest of the bleeding (vol. x. of these ARCHIVES). H.

66. Three cases of defect of the nasal partition, one of which is considered a congenital arrest of development, the other is mentioned as "traumatic perichondritis." In none of the three could syphilis be detected. V. BREMER.

67. BOVILL found in a Hindoo, 40 years old, a rhinolith, which had to be crushed with the bone-forceps before its removal became possible. The removed pieces weighed 160 grs. Before the removal there existed, besides obstruction and suppuration, swelling of the whole half of the face and facial paralysis. H.

68. CHATELLIER relates fully the microscopical examination of two mulberry-like hypertrophies of the posterior extremities of the lower turbinated bodies. He sums up the result of the examination as follows: that the growths consist of adenoid and mucous tissue, the one preponderating at one place, the other at another. The author appears to have considered the condition as one of myxomatous degeneration of the mucous membrane.

69. CHATELLIER found the same changes in the hypertrophies taken from the central and anterior part of the lower turbinated body.

70. CLAVERIE gives in a paper, containing 61 pages, a general description of the history, pathology, etiology, frequency, symptomatology, diagnosis, prognosis, and treatment of the primary malignant tumors of the nasal cavity. H.

71. MOURE's patient, a woman 43 years of age, had suffered for seven months when first seen, with frequently returning epistaxes. The examination revealed a red tumor of the size of a cherry-stone upon the anterior extremity of the middle turbinated body, which bled even when slightly touched with a probe or with a cotton plug. Operation was refused. The tumor grew in the course of a year so rapidly that the nose was completely obstructed, the other nasal cavity being closed by the dislodged septum. One year and a half after the first appearance the operation was performed. As a galvano-caustic loop could not be applied around the tumor, the nasal cavity was laid bare by an incision, running from the inner canthus downwards. The tumor

was successfully removed by means of the forceps and the sharp spoon. The operation was facilitated by Moure's knowledge, from the former examination, of the point of origin, which was then scraped out with the curette and sharp spoon, whereupon the bleeding soon stopped. Seven months after the operation no relapse whatever had occurred. The microscopical examination revealed a fibro-sarcoma. H.

72. DUBREUIL removed with Maisonneuve's loop a nasopharyngeal polypus (fibroma) springing from the base of the pterygoid process, without any bleeding whatever. S.

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#### REVIEW.

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**Photographic Illustrations of the Anatomy of the Human Ear.** By B. Alex. RANDALL and HENRY LEE MORSE. P. Blakiston, Son, & Co., Philadelphia. 1887. Price \$5.

This very valuable work consists of 25 plates with 75 photographic illustrations mounted on pasteboard, very convenient to handle and pass round in a lecture room. The most important parts of the normal anatomy of the ear and a few pathological conditions of the drum-membrane and ossicles are illustrated. The bony parts occupy 14 plates, the drum-membrane 4, and microscopical sections of the external, middle, and inner ear 7. The work is a worthy counterpart of the celebrated photographic atlas of Rüdinger. It was with great pleasure that we have examined the photographs, compared many of them with corresponding specimens, and read the 18 pages of explanatory text. We can heartily recommend the collection to our readers. It will be a very agreeable repetition for the expert, and a great aid to teachers and students. H. KNAPP.

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#### MISCELLANEOUS NOTE.

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Our esteemed collaborator, Dr. H. STEINBRÜGGE of Giessen, has been appointed extraordinary professor.

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*b.* Write without breaks, *i. e.* do not begin a new sentence on a new line. When you want to begin a new line or paragraph at a given word, place before it in your MS. the sign ¶.

*c.* Draw a line along the margin of such paragraphs as should be printed in smaller type—for instance, all that is clinical history in reports of cases, etc.

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